Power Engineering

OCTOBER, 1953

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Heat Your Fuel Oil Right 80

How to Prevent Crane Accidents 82

What Does Painting Cost? 90

Small Boiler Modernization 96

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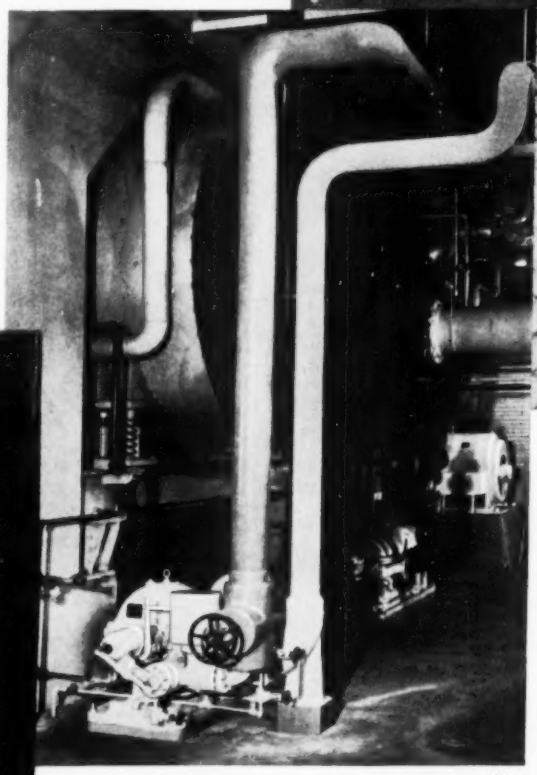
TECHNICAL PUBLISHING COMPANY • CHICAGO, ILLINOIS

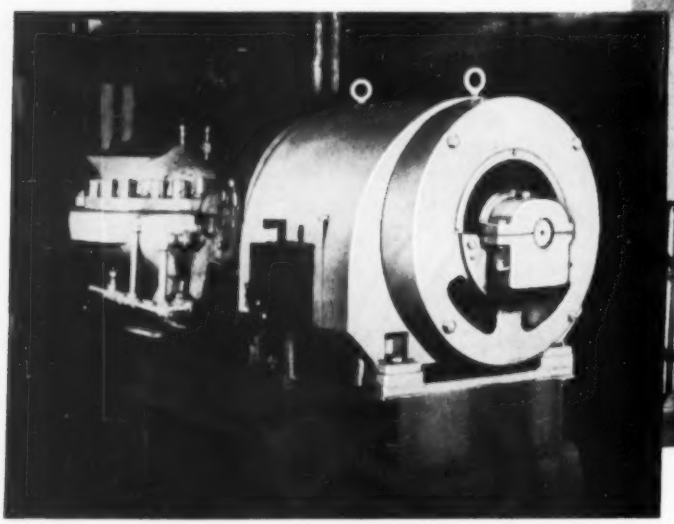
The *sixth* ELLIOTT unit f

● Called a model plant, the Piqua, Ohio, utility has since its inception installed a succession of Elliott turbine-generator units. In 1933 two 4000-kw units started operation. Growing power demand brought the addition of another 4000-kw Elliott unit in 1939. Further expansion in 1946 saw the installation of a 7500-kw condensing turbine-generator and a 1000-kw noncondensing unit supplying process steam to an 8-in. distribution line. But Piqua continues to thrive and grow, dictating the recent installation of their largest unit, a 10,000-kw Elliott turbine-generator unit. Besides the turbine-generators, other major and auxiliary equipment in the Piqua plant is also Elliott, making the plant one in which Elliott Company feels a deep and abiding interest.

One end of the Elliott 12,000-sq ft divided water-box surface condenser which serves the new 10,000-kw turbine. In the immediate foreground, an Elliott 25-hp turbine, and in the middle distance, an Elliott 25-hp motor, both driving condensate pumps. In the background, an Elliott 200-hp motor driving an induced-draft fan.

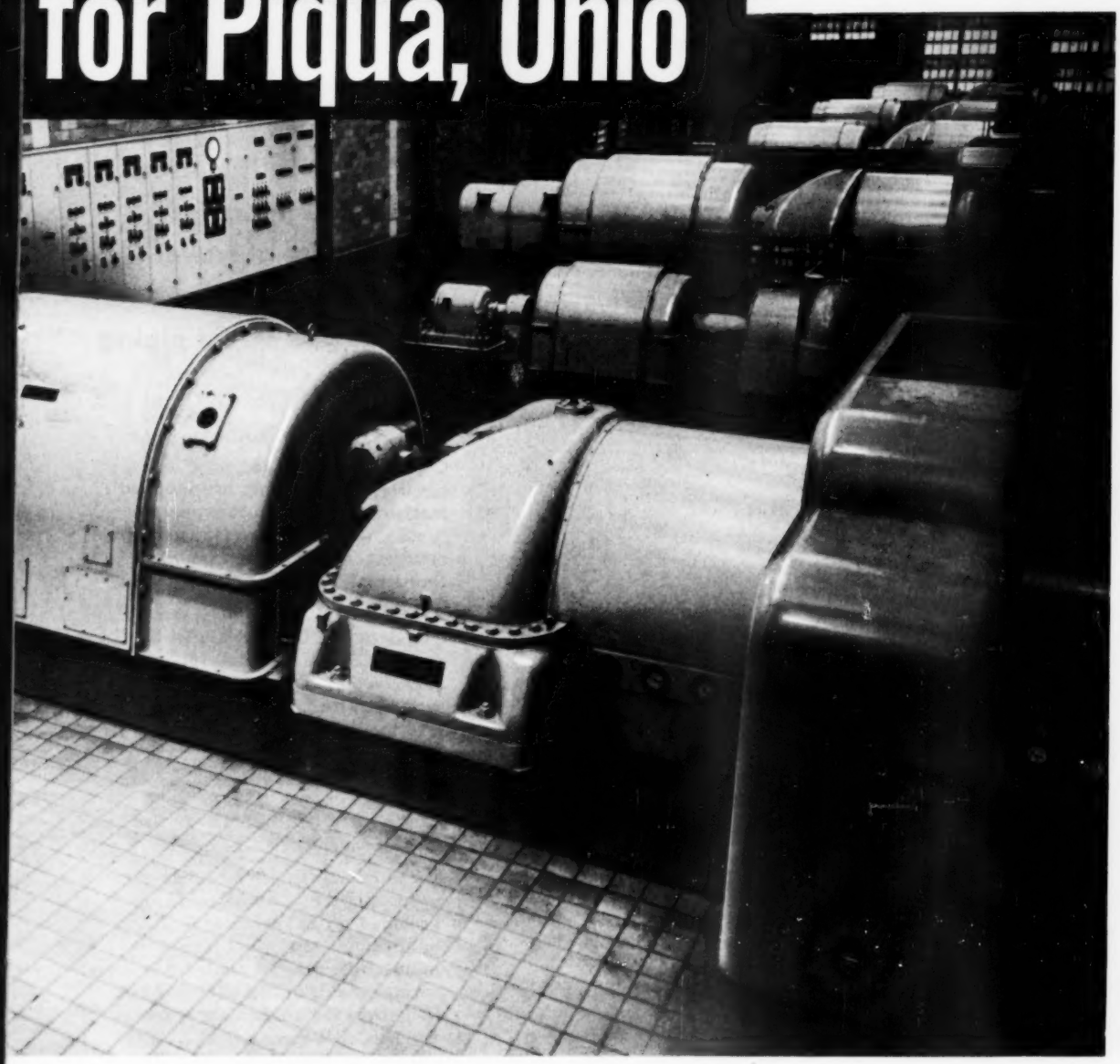


Close-up of an Elliott 200-hp, 3600-rpm motor driving a boiler-feed pump.



H3-4

for Piqua, Ohio



THE BIG PARADE of Elliott turbine-generators at Piqua began in 1933 with the two units in the far background of the above photo, continued through several more installations, and is brought up to date with the recent addition of the 10,000-kw turbine-generator unit in the immediate foreground.

For complete details on Elliott turbine-generators, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

STEAM TURBINE DEPARTMENT

For more data circle 501 on Post Card

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OCTOBER 1953
VOL. 57 • NO. 10

Four 45,000 hp fixed-propeller turbines drive these generators (center) at TVA's Wheeler Dam

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ENGINEERS' PREVIEW

FIRST we had electrons, then we had neutrons and protons, along with positrons, mesons and other nuclear particles. Now they tell us that we have a neutral V-particle, a mysterious radiation from the nucleus of the atom.

Research by scientists of the Brookhaven National Laboratory have discovered unusual V-shaped tracks in a magnet cloud chamber exposed to powerful cosmic rays and subsequent work in Europe and America has determined that these are made by disintegration of unstable neutral particles forming protons and mesons, components of the nucleus, the heart of the atom. A search for neutral V-particles has been carried out at the University of Chicago but the results were inconclusive. At Brookhaven an average of one nuclear event involving a neutral V-particle is found for each 2000 photographs taken of 2,000,000,000 neutrons passing through atoms of hydrogen in a cloud chamber.

* * *

BALDWIN-WALLACE COLLEGE, Berea, Ohio, has joined with Illinois Institute of Technology in offering a combined educational program in liberal arts and engineering.

Under the program students receive a twofold education: they earn degrees in both liberal arts and engineering at the same time.

Addition of the combined program at Baldwin-Wallace brings to 18 the number of schools participating with Illinois Tech in this educational plan.

* * *

CANNING a 12-ton steel ingot, containing most of its original heat, and shipping it many miles from the furnace producing the steel to a shop where it is made into finished products seems like quite a job, but it is being done successfully, according to American Iron and Steel Institute.

Sending ingots cold involved a double waste of time. First, for cooling the steel and second, for restoring its proper temperature for forging. So they designed a specially insulated container, in which the ingots can be placed at 1300 to 1400 F. In this container the steel can be carried from furnace to forge shop with a loss of only about 200 F and can be brought up to forging temperature in eight hours. The container is composed of asbestos sandwiched between layers of heavy steel sheath.

* * *

FOR THE FIRST time in its 66-year history, Commonwealth Edison asked in June for the first general rate increase. In the case of the average residential electric customer of Edison and its Public Service division who uses 161 kwh a month, the increase would amount to approximately 50 cents a month. Against its 66-year history of no general rate increases, Edison has had 26 electric rate reductions. Public Service has had two increases resulting from the inflation of World War I, as against 37 electric grade reductions and important gas rate reductions during its 42-year history.

ARTIFICIAL RESPIRATION REPRINTS

We have received so many requests for tear sheets of the article "Artificial Respiration — New Improved Methods," in the July issue, that we have had reprints made of it to send free to those wanting copies. To obtain copies, merely write "Respiration," with the number of copies you want, on the prepaid postcard you will find elsewhere in this issue and mail it to us. Your copies will be mailed at once.

EXPENDABLE electric motor that packs 25-hp into its 10 lb helps our Navy's submarine crews to guide their deadly torpedoes on a true course. The useful working life of the motor is but a fraction of a second — then it is blasted apart.

While engineering details of the motor are restricted for security reasons, it was revealed that its sole "life work" is to serve as a starter for the torpedo's gyroscope — the guide mechanism which keeps a torpedo on its predetermined course. A small prong at one end of the motor shaft meshes with the gyro's flywheel as the torpedo is shot from its tube. In about one-fifth of a second, the flywheel is spinning at upwards of 13,000 rpm and the job of this little motor is completed.

When the desired speed of the flywheel has been attained, the motor automatically uncouples from the gyro, and its job is done. Seconds or minutes later, depending on the distance from the submarine to its objective, the torpedo strikes its mark and blasts the target apart.

A standard 25-hp motor for industrial use is some 16 in. in diameter, 22 in. long and weighs 415 lbs. The expendable motor is 3½ in. in diameter, 10 in. long and weighs 10 lb.

* * *

JOPPA — big plant, fast, for more AEC power, is how we titled the article by P. E. Gourdon of Ebasco in our November 1952 issue. That was certainly the intention in designing and constructing the plant because the big project at Paducah, Ky., needs the power from both Joppa and Shawnee. However, there has been a constant stream of disturbing reports of strike after strike that delayed the construction of Joppa. Now we learn that Ebasco Services, Inc., has relinquished its contract for the job and that Bechtel Corp. has been selected to complete the construction work on Joppa. Cancellation of Ebasco's construction contract was attributed largely to labor troubles that had delayed completion of the project and also had pushed costs far above original estimate. Several enormous projects now being built in the Joppa area have made it one of the most difficult labor markets in the country.

* * *

THAT MEN of today are taller is recognized in a recently revised safety code of American Standards Association. Incorporating the most modern safety practices for protection of operators of power machinery, it now requires the guarding of all transmission equipment to minimum heights of 7 ft.

LEWIS K. SILLCOX, vice-chairman of the board of The New York Air Brake Co., has been nominated for 1954 president of the American Society of Mechanical Engineers. He will succeed Frederick S. Blackall, Jr., of the Taft-Peirce Manufacturing Co. At the same time, the following were nominated for regional vice-presidents: Willis F. Thompson, vice president, Westcott & Mapes; Professor William G. McLean, head of the Department of Mechanics, Lafayette College; Thompson Chandler, chemical engineer with Carbide & Carbon Chemical Corp.; Vernon A. Peterson, district manager for the Elliott Co., Professor Clifford H. Shumaker, director of the Institute of Management, Southern Methodist University.

Those nominated for directors at large are: Frank L. Bradley, plant engineer, Forstmann Woolen Co., and Robert B. Lea of the Sperry Corp.

* * *

THE U. S. NAVY has awarded Westinghouse Electric Corp. a $500,000 order for electrical equipment for a new variable-pressure-water tunnel. It will be built at David W. Taylor Model Basin, in Washington, D. C. An axial-flow, adjustable-blade pump will circulate water in the tunnel. The pump drive includes a 3500 hp synchronous motor and control and associated switch gear for starting and operating it, also a water-cooled eddy-current coupling with speed control, and a water-cooled eddy-current brake made by Dynamatic Corp.

* * *

RED FACE Department. Transposition of a semicolon, a comma, and a line of type resulted in changing the meaning of a sentence in our July issue — an unforgivable editorial offense.

In the article, "Steam from Steel," page 54, column 1, paragraph 1, sentence 2 should read, "In a plant that produces its own coke and operates its own blast furnaces, there is sufficient potential heat energy in waste fuels to generate all power and steam requirements after satisfying every other practical use; however, there are practical limitations to such utilization." The sentence as it now stands implies that this might be true in any steel plant; but if they produce their own coke and operate blast furnaces, there will be limitations.

* * *

RECENT intense campaign to reduce the nation's critical shortage of engineers is starting to pay off, says Louis M. Stark of Westinghouse. While the picture is far from bright, he says, it is heartening to note a 29 per cent increase in the number of college and university freshmen who enrolled in engineering courses in 1952.

* * *

CALIFORNIA OREGON POWER CO. has ordered two automatic hydroelectric packaged power plants from Westinghouse Electric Corp. They will be installed at the Lemolo No. 1 and No. 2 generating stations on the North Umpqua River east of Roseburg, Ore. These power plants, consisting of waterwheel generators, transformers, and switchgear, will add 62,000-kw of electrical capacity to the utility's system. Lemolo No. 1, a single-unit, 29,000-kw outdoor automatic plant, is scheduled to begin operation in 1954. Lemolo No. 2, a single-unit, 33,000-kw outdoor automatic installation, is scheduled for completion in 1955.

BROAD SALES and manufacturing rights for the North American Continent have been granted the Cleaver-Brooks Co., by Escher Wyss Co. of Zurich, Switzerland.

Escher Wyss Ltd. designs and manufactures hydraulic turbines of Kaplan, Francis and Pelton type, pumps, steam and gas turbines, centrifugal and axial flow compressors, heat exchange apparatus and evaporation equipment.

Cleaver-Brooks has also taken an active part in the development of the compression evaporator. Heart of this evaporator is the compressor. It was Cleaver-Brooks' search over the past decade for the most advanced compressor designs and the finding of such designs at

This vapor compression evaporator, one of largest in the world, with a capacity of 250,000 lb per hr, was built by Escher Wyss of Zurich, Switzerland

Escher Wyss that first brought the two concerns together.

Another contributing factor to the granting of the North American rights was Cleaver-Brooks' research in the concentration and disposal of spent sulphite liquor in paper mills. The arrangement between the two companies will entail the Americanization of Swiss designs, and the establishment of sales and service organizations.

* * *

PROCEEDINGS of the American Power Conference are published annually in a cloth bound volume, usually containing 500 to 600 pages. Sales of these proceedings enables the conference to operate without going into debt. Copies of the proceedings of the 1953 American Power Conference, at $6.00 per copy, can be obtained from the director of the conference, Dr. R. A. Budenholzer, Illinois Institute of Technology, 3300 Federal Street, Chicago 16, Ill.

* * *

ONE OF THE most effective areas of growing cooperation between industry and higher education is in providing of company scholarships, as we have previously pointed out in these columns, to worthy young men and women. However, Robert F. Herrick, director of the department of public relations of Lehigh University at Bethlehem, Pa., points out there is a surprising lack of information on the part of industry as to the terms on which such scholarship programs may be undertaken. Accordingly, Lehigh University has prepared a summary of the provisions of company scholarships, as gathered from its experience with 27 firms. Copies of this summary are available directly from Mr. Herrick at the university, at the above address.

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INTERCRYSTALLINE CORROSION

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Photomicrograph of edge of crack caused by intercrystalline corrosion. U. S. Bureau of Mines detection unit (inset) tests for causes of intercrystalline corrosion.

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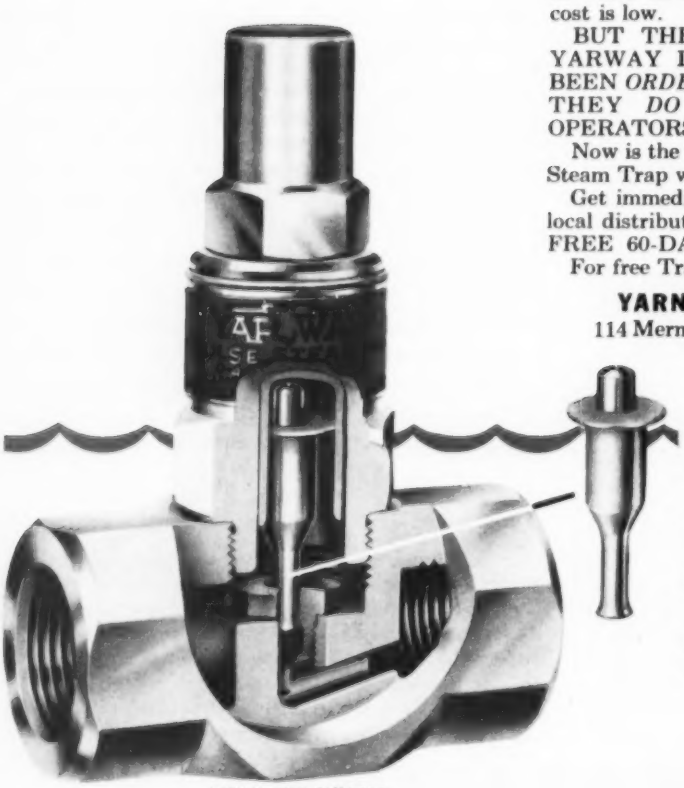

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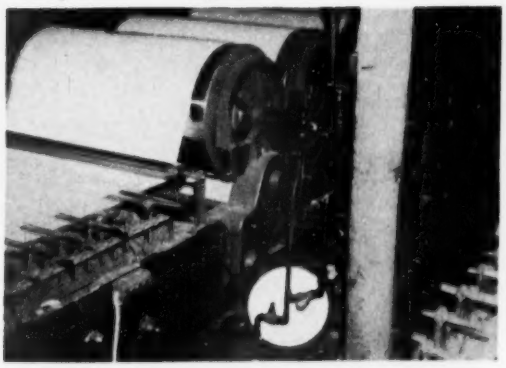
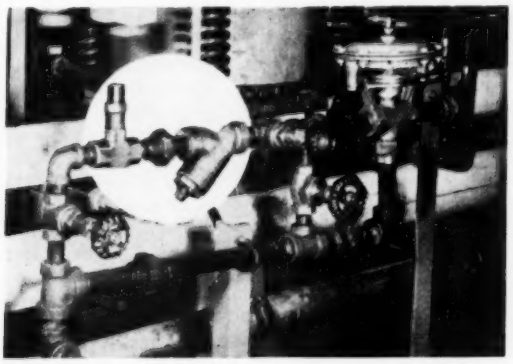
50 FT. MORE FLAT-WORK PER MINUTE after ***LAUNDRY*** equipped 8-roll ironer with Yarway Traps. ▼





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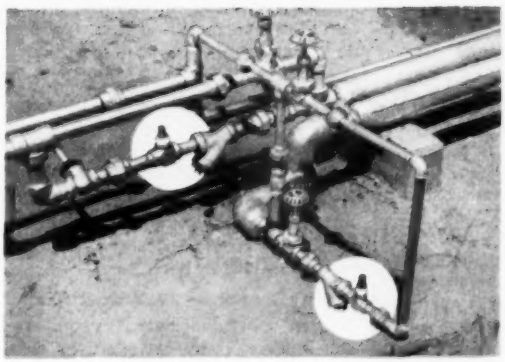
5 MORE BATCHES PER DAY from cooking kettles when ***TOMATO CANNERY*** installed Yarway Traps. ▲



◀

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impulse® steam traps

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COPPER ALLOY BULLETIN

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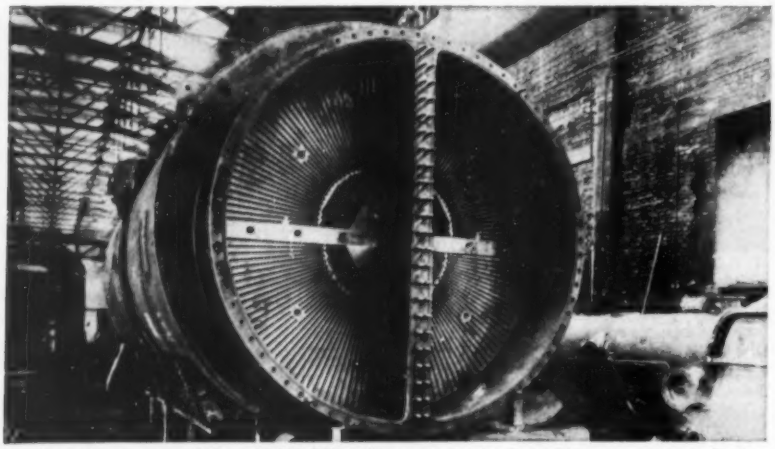


Condenser to serve one of three 30,000 KW turbine units for the Porto Marghera station at Venice, Italy, operated by the Società Adriatica di Elettricità. Designed and constructed by Franco Tosi, Legnano, Italy.

Steam Power Expansion in Italy

The Porto Marghera (Venice) Station

The rising strength and vigor of the industrial progress which has been made in Italy is exemplified by the huge expansion of the postwar power program. One of the largest installations which is nearing completion, is the Porto Marghera central power station operated by the Società Adriatica di Elettricità, Venice.

The original units consisted of two turbines, each with a capacity of 15,000 KW. They will be replaced later by a modern 20,000 KW unit.

Already completed are two units—a 30,000 KW and a 60,000 KW. Another 60,000 KW unit is in the planning stage. When this plant is completed, it will produce over 200,000 KW, supplying all of the power for the whole northeastern portion of Italy.

The plant contains the latest types of machinery and equipment designed for full automatic operation. Franco Tosi (Legnano, Italy) designed and built the three turbine groups, including condensers, and installed the condenser tubes.

Design Features

Air is extracted from the condensers by special two-stage ejectors. The condensate is then preheated by passage through feedwater heaters on its way back to the boilers. The 30,000 KW and 20,000 KW turbines are designed for steam at 520 psi and at 850°F when entering the turbines. The turbine unit of 60,000 KW uses steam at 850 psi and at 900°F.

Three condensers serving three turbine groups totalling 90,000 KW have been equipped with condenser tubes .8661" OD × .042" wall. Each 30,000 KW unit contains 5,250 tubes, 302.76" long. Two circulating pumps serving these condensers handle 8,250 cubic meters of water per hour.

Why Duronze IV Was Chosen

Bridgeport Duronze IV condenser tubes have been installed in three condensers and will be used for the second group of 60,000 KW. Duronze IV contains 95% copper, 5% aluminum and 0.25% arsenic. It was chosen because of its resistance to corrosion from harbor waters polluted with sewage and industrial waste. This alloy withstands impingement corrosion better than Admiralty and Aluminum Brass under these conditions.

Extensive air-impingement corrosion tests conducted in salt water contaminated by sewage indicated that Duronze IV is more resistant to this type of attack than non-arsenical Aluminum Bronze of the same copper-aluminum composition. However, due to its high corrosion resistance, Duronze IV is susceptible to fouling by marine organisms. This is explained by the fact that it has a low rate of solubility in sea water and therefore does not introduce to the water film, adjacent to its surface, enough copper salts to be toxic to marine organisms.

Living organisms may obstruct the flow and affect the heat transfer rate. However, dead organisms, particularly barnacles, when allowed to remain attached to the surface of the metal, often lead to pitting. Under conditions where biofouling is severe, such as in warm, clean sea water, care should be taken to keep the Duronze IV tubes as clean as possible. The water velocity should be maintained high enough (continuous at 6 feet per second or higher) to prevent marine organisms from attaching themselves to the metal surface. Chlorination should be sufficient to discourage biofouling. Dead marine organisms, particularly barnacles, should be promptly removed by mechanical means.

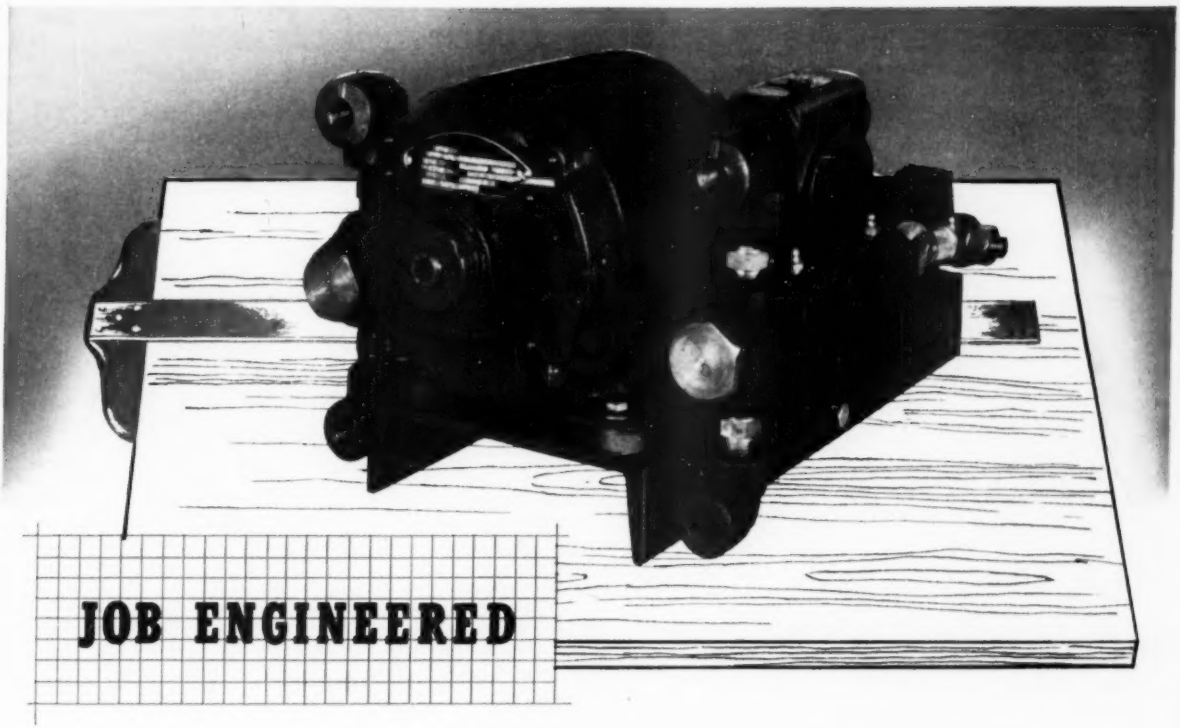
In common with other copper-base alloys, Duronze IV shows excellent corrosion resistance to steam and steam condensate. However, steam condensate contaminated with ammonia may lead to stress corrosion cracking. This alloy is not recommended for service involving high concentrations of ammonia. Here Duplex tubes with steel to the ammonia side and a copper-base alloy to the water side are very satisfactory.

Duronze IV shows good to excellent resistance to a wide variety of fresh waters especially those polluted with paper mill wastes.

Bridgeport's corrosion laboratory staff will be glad to cooperate with users of condenser, heat exchanger, and Duplex tubes in regard to their corrosion problems and tube requirements.

(430)

For more data circle 546 on Post Card



JOB ENGINEERED

H-20 PUMP FOR DEPENDABLE LOW-COST SERVICE

For water treating services, and other applications that do not need the extremely high accuracy of Step-Valve liquid ends, Milton Roy offers the performance-proved H-20 Controlled Volume Pump.

This rugged pump has already gained wide acceptance in a variety of applications . . . in water treating installations, dry cleaning plants, bottling works . . . and as components of packaged steam boilers.

CAPACITIES: 3 to 12 gallons per hour in standard models.
MODELS: Simplex or Duplex (illustrated).
DISCHARGE PRESSURES: To 600 pounds per square inch.
MATERIALS OF CONSTRUCTION: Cast Iron and Stainless Steel.
PRICE: As low as $174.00 for cast iron construction, stainless steel trim, 300 psi discharge pressure, 6 gallons per hour maximum, ⅓ hp motor, single phase, 60 cycles, 115 volts, open.

Truly job-engineered, this dependable, low-cost H-20 pump includes such design features as double ball-checks on suction and discharge . . . spring-loaded packing that insures proper tension . . . construction for mounting any standard NEMA frame ¼ hp or ⅓ hp motor . . . simplicity in converting to duplex model.

H-20 is the latest product of Milton Roy . . . manufacturing engineers of controlled volume pumps and complete chemical feed systems for all industry.

For complete illustrated technical data, write *today* for *new free Bulletin H20M.*

MILTON Roy COMPANY
Manufacturing Engineers
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CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

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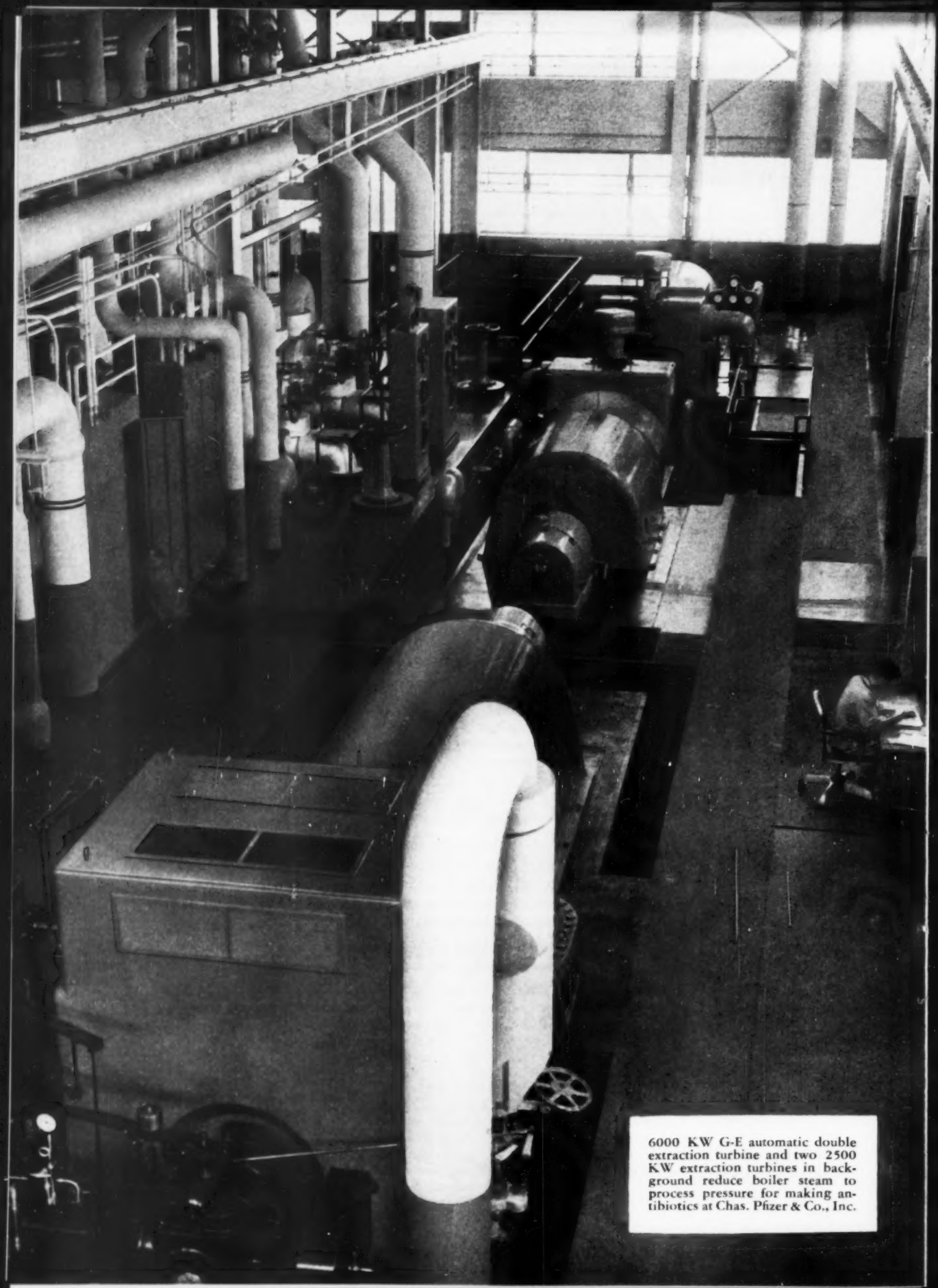


6000 KW G-E automatic double extraction turbine and two 2500 KW extraction turbines in background reduce boiler steam to process pressure for making antibiotics at Chas. Pfizer & Co., Inc.

G-E Extraction Turbine at Chas. Pfizer & Co., Inc. Increases Plant Thermal Efficiency Over 15%

Extraction pressures held constant, even under varying loads; turbines reduce boiler steam to process pressures for use in making antibiotics

Plant thermal efficiency was increased over 15% when Chas. Pfizer & Co., Inc., producer of antibiotics, recently installed the third General Electric automatic extraction turbine-generator at its Groton, Connecticut, plant. A 6000 KW extraction unit was installed to take fullest advantage of available high-pressure steam, and to obtain additional economical by-product power.

PRESSURE HELD CONSTANT

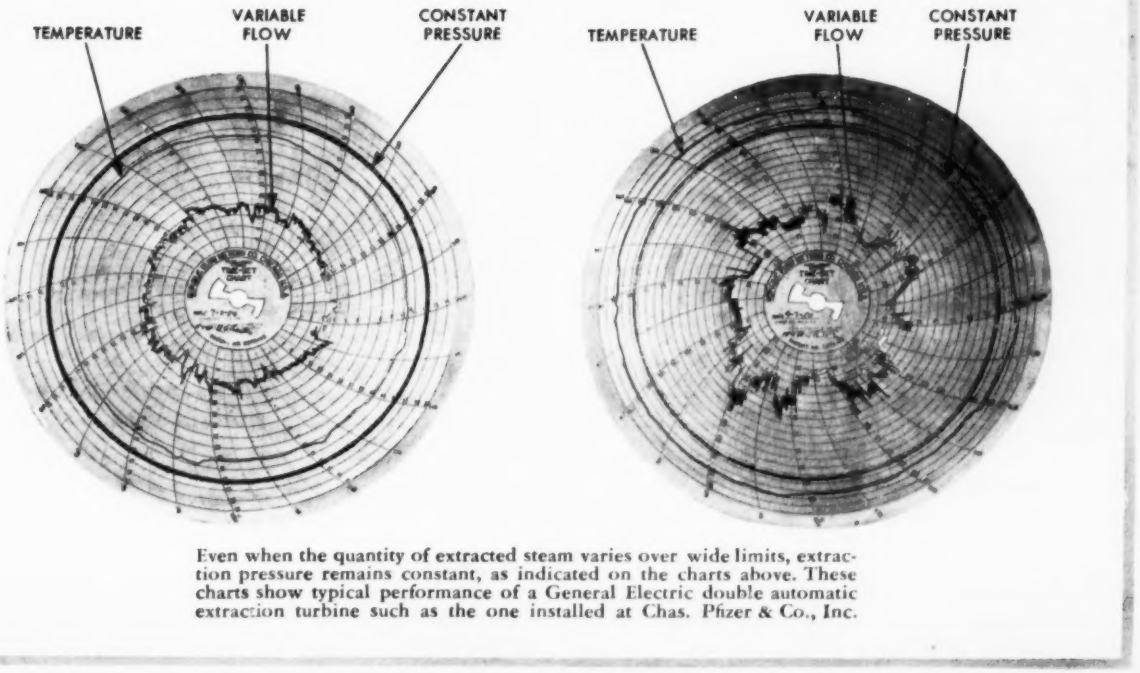
The double automatic extraction turbine takes steam at 725 F, 600 psig, and extracts at 135 and at 50 psig for plant process uses in the making of terramycin and other antibiotics. Chas. Pfizer & Co., Inc. reports that accurate turbine governing holds electrical frequency constant, and keeps extraction pressures precise, even when the quantity of extracted steam varies. (See charts below.)

If your plant uses process steam, why not take advantage of G.E.'s experienced turbine engineering resources. G-E engineers will study and recommend ways for you to best utilize steam supply. Get more for your turbine dollar with G-E turbine-generators. General Electric Company, Schenectady 5, New York. 256-8

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

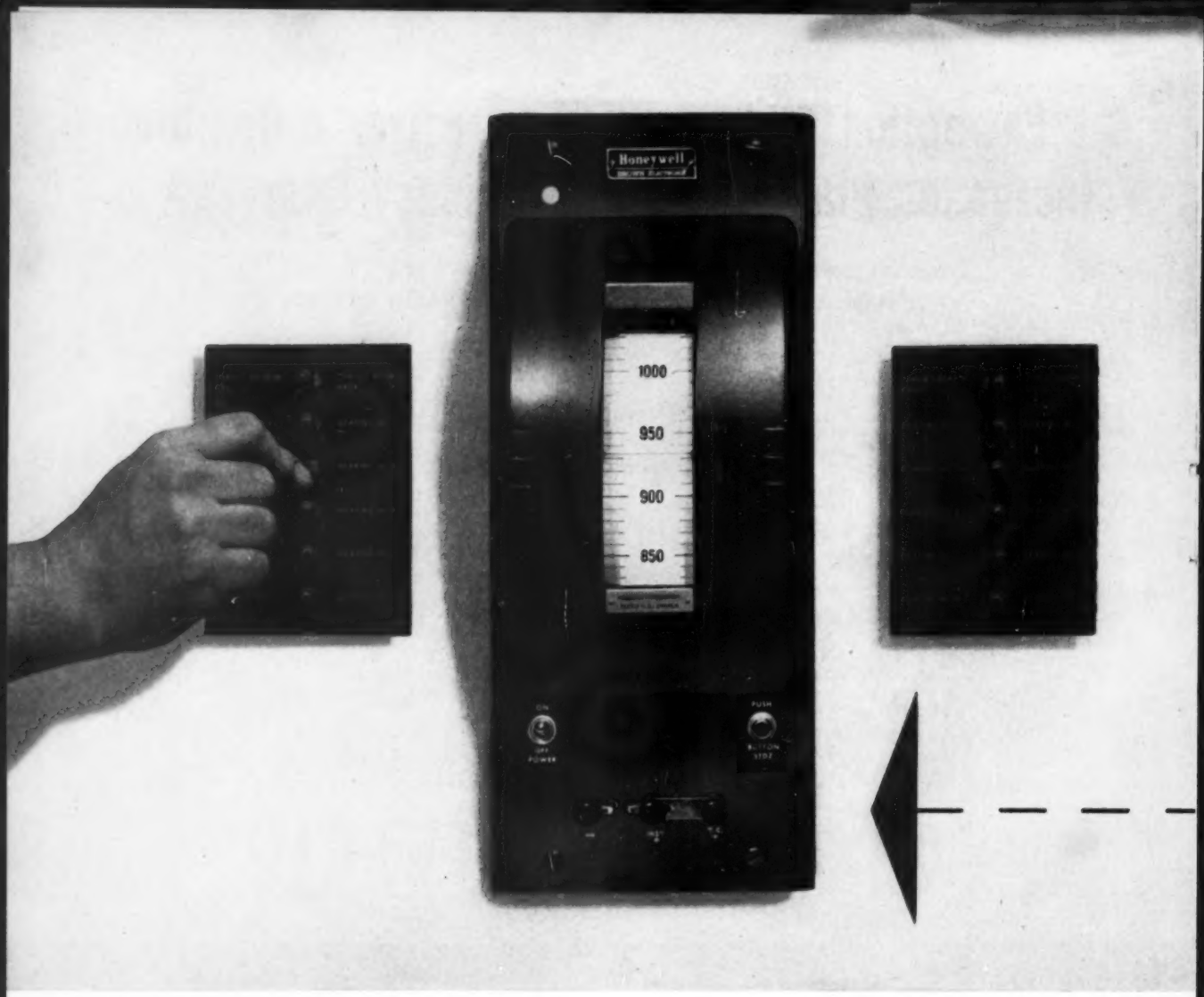
You can put your confidence in—

GENERAL ELECTRIC



Even when the quantity of extracted steam varies over wide limits, extraction pressure remains constant, as indicated on the charts above. These charts show typical performance of a General Electric double automatic extraction turbine such as the one installed at Chas. Pfizer & Co., Inc.

For more data circle 507 on Post Card



Look at these features!

compact case
approximately 6½ inches wide by 15⅜ inches high

easily-read drum scale
rotates vertically; graduated length 28⅝ inches provides big, legible scale divisions and numerals.

accurate hairline index
eliminates parallax errors, permits high readability.

fast measurement
full scale rotation in 4½ or 12 seconds for 60-cycle operation.

external key switches
can be located at the side of the indicator (as shown), below or above—wherever most convenient for the particular panel layout.

large number of points
additional key switch banks provide any desired number of temperature points. Legend plates facilitate identification.

high precision
calibrated accuracy is 0.2% of scale span.

variety of ranges
supplied for use with either thermocouples or resistance thermometers, in a selection of ranges applicable to power plant temperatures.

Squeezed for panel space?

THIS NEW

Honeywell temperature indicator

needs no elbow room!

CROWDED PANELS are no problem for this new temperature instrument . . . the Vertical Scale Precision Indicator. Its slender, compact case makes it a natural for graphic panels—and a readily-inserted, space-saving member of conventional generator and turbine boards.

Basically, it's the same *ElectroniK* Precision Indicator which the power industry and many others have used and relied upon for many years. But, its outside appearance has changed: it's a completely new design that places the bulk of the instrument mechanism *behind* the panel . . . uses the valuable front-of-panel space primarily for the indicating scale.

Equipped with key switch banks, the Vertical Scale Precision Indicator offers a fast, convenient way to spot-check temperatures in bearings, pumps, hydraulic couplings, motors and other potential hot spots.

Your local Honeywell engineering representative will be glad to discuss how this new instrument can save space on the new panels which you may be planning. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Bulletin No. 1541 on the Vertical Scale Precision Indicator.**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

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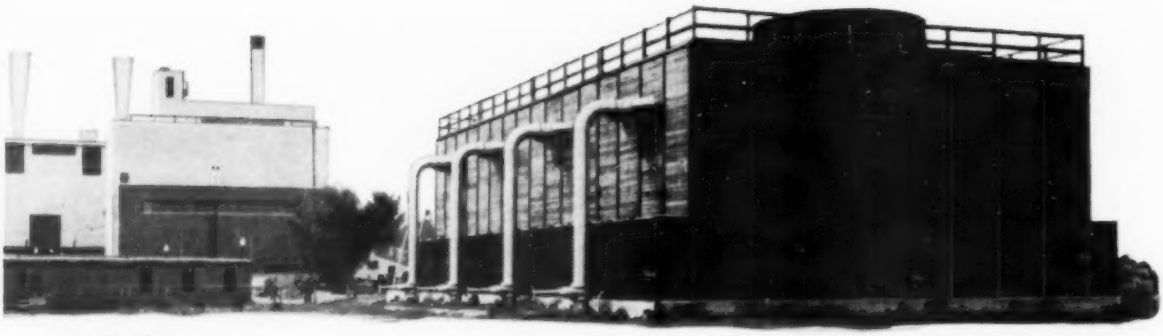

MODERN PLANTS NEED PRITCHARD!

The Pritchard Heavy Duty Cooling Tower pictured here was designed and constructed for the St. Joseph Light & Power Co., St. Joseph, Missouri. This mechanical draft tower has the capacity to cool water from 115° F down to 95° F at the rate of 21,400 gallons per minute. The amount of water conserved for re-use by this Pritchard tower amounts to about *twice* the total rate of water consumption for the entire city of St. Joseph.

Such dependable performance and vital water conservation is Pritchard's answer to industry's demand for modern, efficient cooling tower operation. Pritchard's long experience and constant research produce towers that are designed *right* . . . engineered with adequate capacity . . . to do any required cooling job. Exclusive design features and rugged long-life construction assure top value . . . both in first cost *and* operating costs.

Farsighted industrial leaders—like the officials of the St. Joseph Light & Power Company—are giving top priority to modernization plans for conserving water and improving plant efficiency. That goal is the reason so many of these men depend on Pritchard—a founder member of the Cooling Tower Institute. They know that whether modernizing or expanding they can depend on the *guaranteed performance* of a Pritchard Heavy Duty Cooling Tower.

Whatever your cooling tower need, solve it easily by contacting your nearest Pritchard representative listed in the classified section of your telephone directory or write direct to Pritchard's General Offices, Kansas City, Mo.

Pritchard QUINTAIR* Air-Cooled Heat Exchangers

This quality Pritchard unit guarantees modern cooling efficiency . . . provides low-cost, dependable cooling of engine jacket water or lubricating oil; condensing and cooling of hydrocarbons and steam; money-saving operation in other process cooling service. A single unit may be used for two or more simultaneous cooling jobs. Long, trouble-free service is assured by quality Pritchard construction. Practical Pritchard design makes all parts that may require attention readily accessible for quick, easy inspection and maintenance. Completely fabricated . . . shipped ready for fast, easy installation.

** Registered Trade Name*

Industry's Partner for Progress

Cooling Towers
Specialized Heat Exchangers
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LADISH *Controlled Quality* ASSURES METALLURGICAL SOUNDNESS

Photographed in Ladish
Metallurgical and Research Laboratories

TENSILE TEST

One of many comprehensive Ladish laboratory test procedures for assuring reliable performance.

TO MARK PROGRESS

Testing the breaking point of metal... proves Ladish fittings have ample strength to meet the test of maximum service

Optimum strength — proved by scientific test — typifies the outstanding values in Ladish fittings that result from special emphasis on sound metallurgy and advanced facilities. Shown here is modern Universal tensile testing equipment on which ultimate strength, yield strength, reduction of area and elastic properties are carefully measured to assure users of Ladish Controlled Quality fittings the metal quality essential for reliable performance.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF... ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
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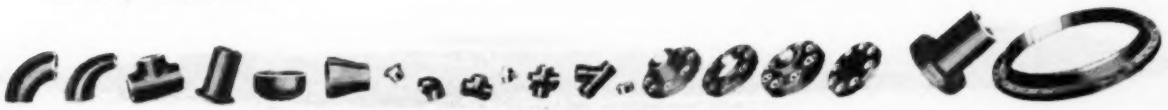
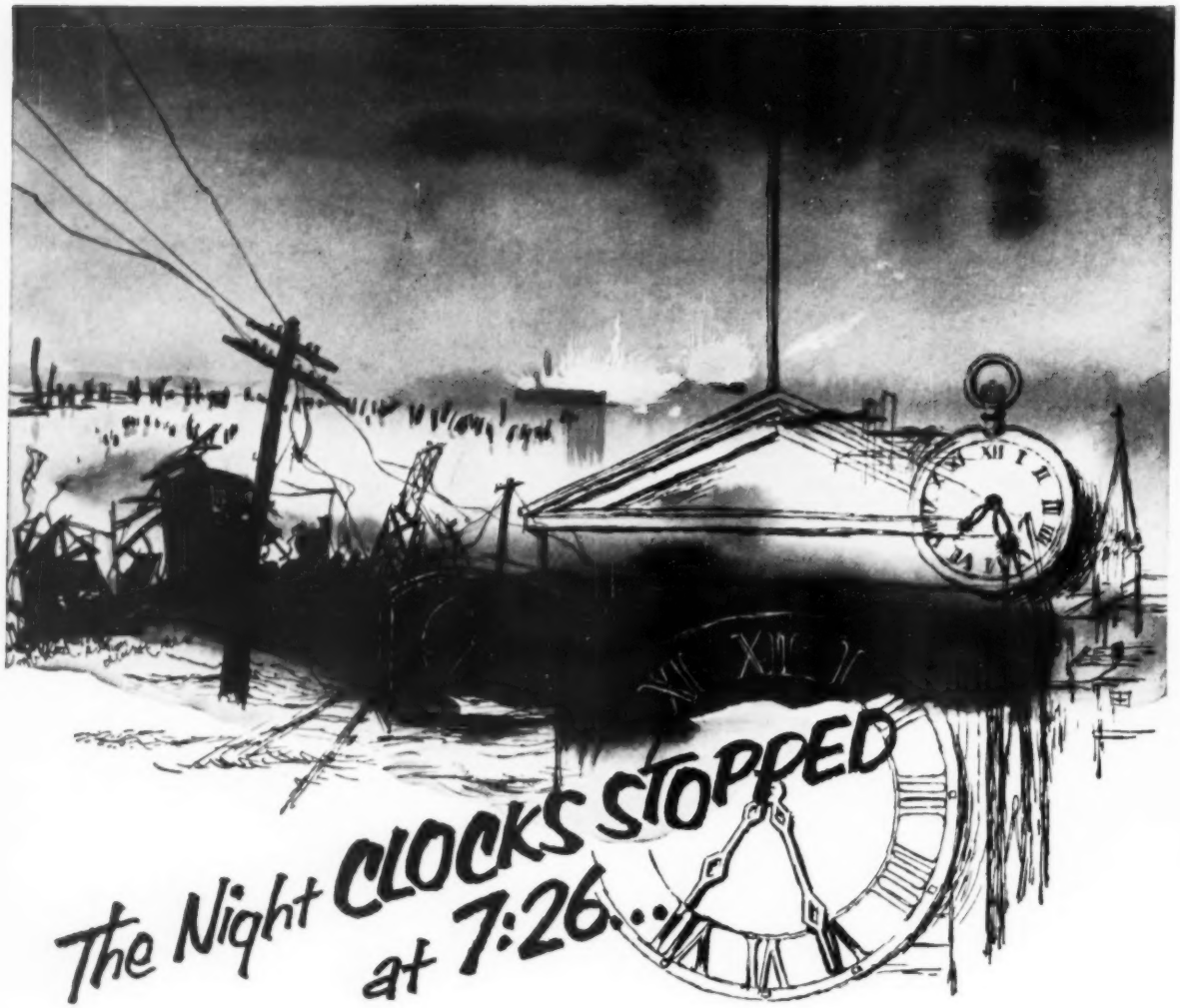




Some 9,500 people were in South Amboy, N. J., that drizzly evening in 1950. At the waterfront, longshoremen were transferring the last of 12 freight cars of ammunition to lighters that would carry it to a waiting vessel in Raritan Bay.

But the City Hall clock never got to 7:27—and the freighter's deadly cargo never got loaded. Explosions shattered windows over a radius of 12 miles; and hundreds of people looked at their arms and legs and saw that flying daggers of glass had stabbed them.

At dawn, 312 of the injured had been counted.

★ ★ ★

Such disasters have happened many times before in America. They could happen again. And *if* they do—and *when* they do—there must be blood plasma on hand to take care of the injured. For blood saves **lives!**

But blood cannot be mined or manufactured. It must come from the veins of healthy men and women. Men and women who feel concern for a suffering neighbor. So give blood—now!

Whether your blood goes for Civil Defense needs, to a combat area, or to a local hospital—this priceless, painless gift will some day save an American life!

Give Blood Now

CALL YOUR RED CROSS TODAY!

National Blood Program

Business Executives!

✓Check These Questions!

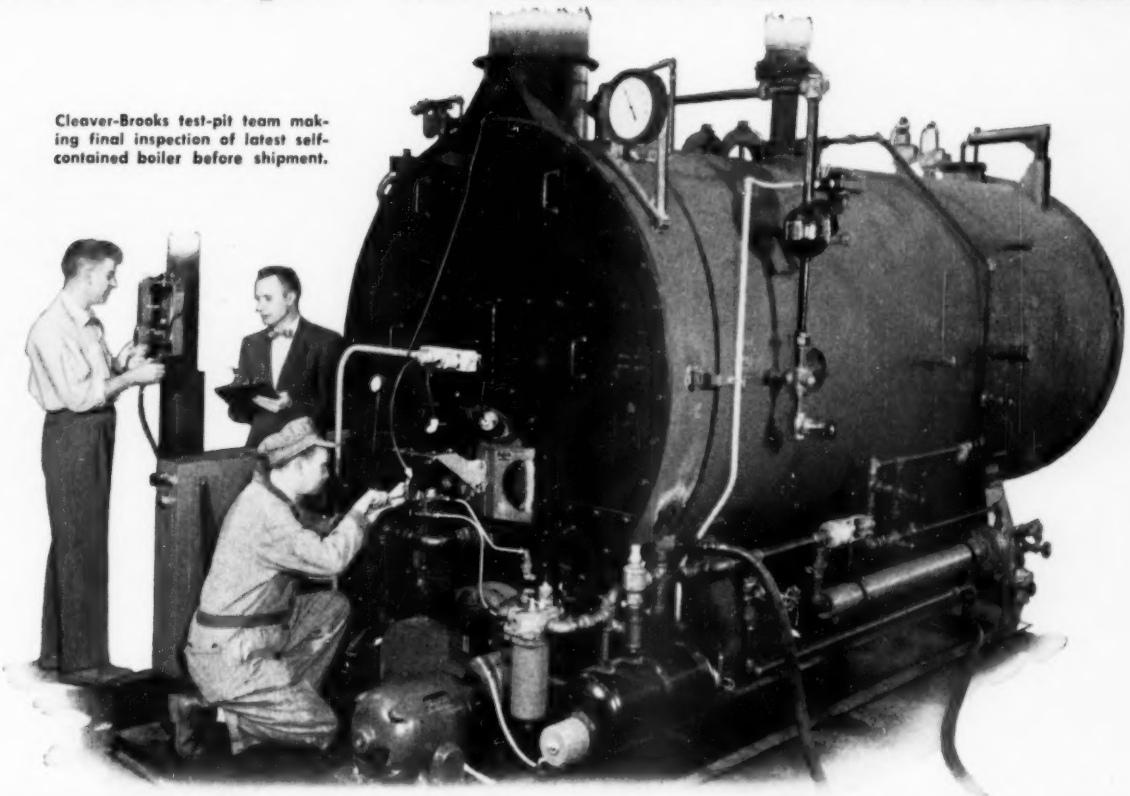
If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ☐ Have you given your employees time off to make blood donations?
- ☐ Do you have a Blood Donor Honor Roll in your company?
- ☐ Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?
- ☐ Have you arranged to have a Bloodmobile make regular visits?
- ☐ Has your management endorsed the local Blood Donor Program?
- ☐ Have you informed employees of your company's plan of co-operation?
- ☐ Was this information given through Plant Bulletin or House Magazine?
- ☐ Has your company given any recognition to donors?
- ☐ Have you conducted a Donor Pledge Campaign in your company?

Remember, as long as a *single* pint of blood may mean the difference between life and death for *any* American . . . the need for blood is *urgent!*

their counterpart "Test-Pilots" have at Cleaver-Brooks

Cleaver-Brooks test-pit team making final inspection of latest self-contained boiler before shipment.



HIGH SCORES . . . on factory and on-job tests guarantee greatest return from boiler investment

When test pilots give the familiar "O.K." — that's the sign of proven performance. It's the same with boilers in the Cleaver-Brooks plant. Only after accurate, thorough inspection and testing under actual operating conditions do boilers get the final "O.K." from experienced test engineers. That's why you get guaranteed 80% efficiency from your Cleaver-Brooks boiler.

A record of this test is available to every buyer on request. In fact, you as a buyer, consultant, or contractor are invited to witness the actual test on your Cleaver-Brooks boiler before shipment.

And further, Cleaver-Brooks boilers are placed in operation at the job site by factory service engineers who check installation, train your operators and make complete and detailed field tests.

So, when you buy a boiler, insist on factory tests as well as field service tests by qualified engineers. There is no better way of insuring yourself of the very best value money can buy and the greatest return from your boiler investment. Look to Cleaver-Brooks, the leader in the "Packaged" Boiler field for two decades. Write today for latest Catalog AD-100.

Available for oil, gas and combination oil/gas firing.

CLEAVER-BROOKS COMPANY
Dept. L-311 E. Keefe Ave.
Milwaukee 12, Wisconsin, U.S.A.

Cleaver-Brooks

Originators of the Self-Contained Boiler

BOILERS — STEAM OR HOT WATER — FOR HEATING AND PROCESSING IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI

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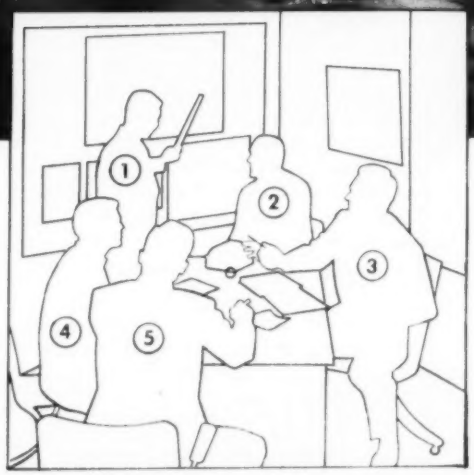

1. Westinghouse Application Engineer
2. Westinghouse Sales Engineer
3. Chief Engineer
4. Electrical Engineer
5. Production Superintendent

Your motor and control problems are local . . . so is Westinghouse application assistance

Do you put a full team on the field when you tackle a motor and control application problem? Are you cashing in on the know-how of your local staff of Westinghouse application engineers? Take a look at this line-up:

Your local Westinghouse sales engineer has a broad knowledge of all Westinghouse Motors and Controls. He knows their capabilities and limitations. He knows how to match motors and controls for maximum production.

Your local Westinghouse application engineer is equipped to analyze any motor and control problem and then develop the best solution. He can handle any application problem from a simple machine tool to a complete production line.

Your local Westinghouse product engineer is a specialist in one type of motor or control. These men work at the local level but operate from a manufacturing headquarters office.

Enlist the services of these men on your next motor and control application job. Call your local Westinghouse office for further details, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21746

Application engineers work out of 126 Westinghouse offices

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Birmingham 3, Ala.	53-2411	Indianapolis 9, Ind.	MArket 3301	Saginaw, Mich.	4-2640	Washington 6, D. C.	NAtional 8-8843
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Butte, Mont.	2-2301	Johnstown, Pa.	81-257	San Francisco 8, Cal.	EXbrook 2-5353	Wilkes-Barre, Pa.	3-1144
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Charlotte 1, N. C.	5-3731	Los Angeles 17, Cal.	MAdison 6-3681				
Chattanooga 2, Tenn.	7-4361	Louisville 2, Ky.	CLay 0212				
Chicago 54, Ill.	WHitehall 4-3860	Madison 3, Wis.	5-4868				
Cincinnati 2, Ohio	GArfield 2250	Medford, Ore.	2-8289				
Cleveland 13, Ohio	CHerry 1-7600	Memphis 3, Tenn.	8-8546				
Columbia, S. C.	3-8823	Miami 4, Fla.	2-1553				
Columbus 15, Ohio	MAin 5527	Milwaukee 2, Wis.	DAly 8-1800				
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Dallas 1, Tex.	RIverside 5231	Mobile, Ala.	8-5443				
Davenport, Ia.	3-2761	Nashville 3, Tenn.	42-3505				
Dayton 2, Ohio	ADams 9153	Newark 2, N. J.	MArket 2-0200				
Denver 2, Colo.	KEystone 8121	New Haven 10, Conn.	5-3191				
Des Moines 8, Iowa	2-0244	New Orleans 13, La.	RAymond 8656				
Detroit 31, Mich.	TRinity 2-7010	New York 5, N. Y.	WHitehall 3-4321				
Duluth 2, Minn.	7-1541	Niagara Falls, N. Y.	9700				
El Paso, Tex.	2-5691	Norfolk 10, Va.	5-1639				
Emeryville 8, Cal.	OLympic 2-3770	Oklahoma City 2, Okla.	REgent 6-1633				
Erie, Pa.	24-867	Omaha 2, Nebr.	HArney 8700				
Evansville 8, Ind.	5-7146	Peoria 3, Ill.	2-5439				
Fairmont, W. Va.	501	Philadelphia 4, Pa.	EVergreen 2-1200				
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YOU CAN BE SURE...IF IT'S Westinghouse

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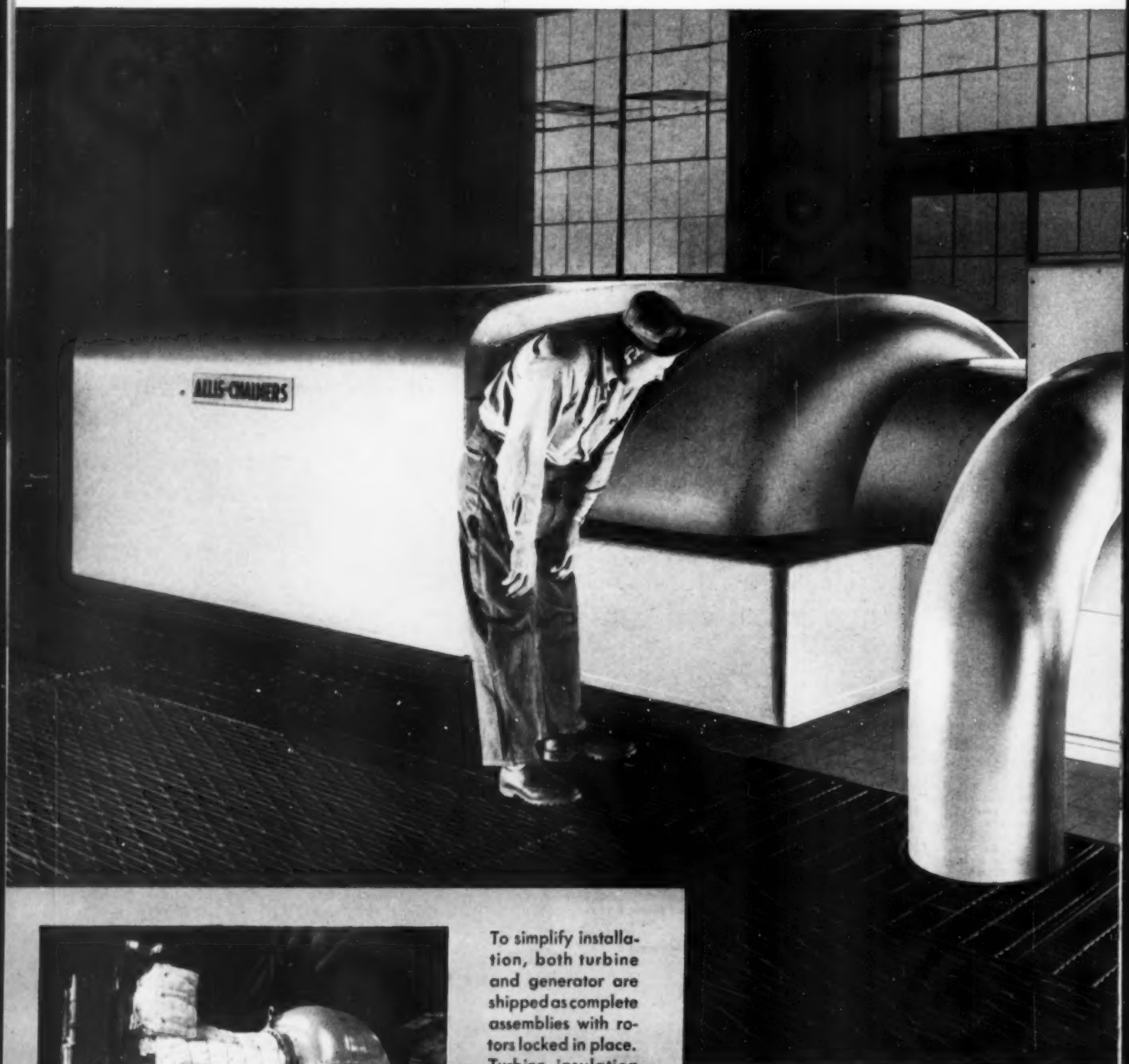
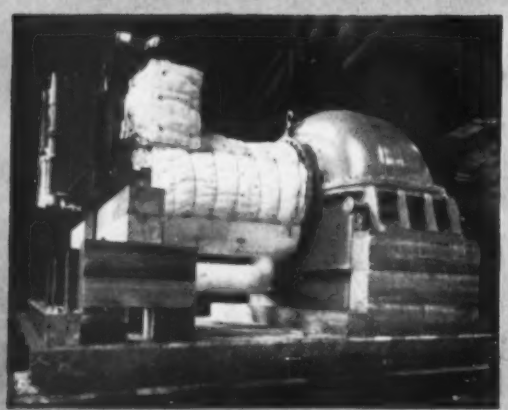
Another



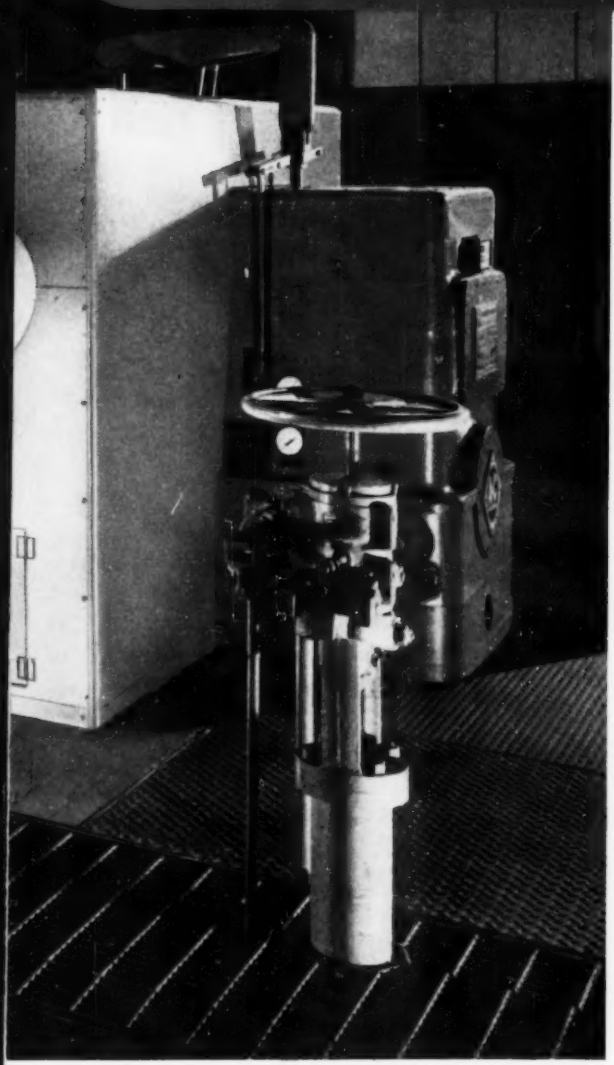


To simplify installation, both turbine and generator are shipped as complete assemblies with rotors locked in place. Turbine insulation is also applied at factory. Illustration at left shows 7500-kw turbine ready to be covered with tarpaulin before shipment.

Attractive appearance of WA-Series turbine and generator is shown above. Unit is rated 7500 kw, with steam conditions of 600 psig, 825 F, 1½ inches mercury absolute. A-C also supplied surface condenser, pumps and motors for this installation.

WA-Series

STEAM TURBINE GENERATOR UNIT



Engineered to Meet Requirements of a Modern Power Plant!

HERE'S another Allis-Chalmers WA-Series turbine generator unit with the kind of design features and performance that power producers everywhere are looking for today.

Available for condensing and non-condensing service, the up-to-date WA-Series impulse turbine design is built in sizes 2000 kw and larger in NEMA standard ratings. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

Simplicity is Keynote

For ease of installation and maintenance, every detail has been designed to assure maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit with simple foundation requirements. And shipment of the turbine and the generator with their rotors in place further minimizes installation costs.

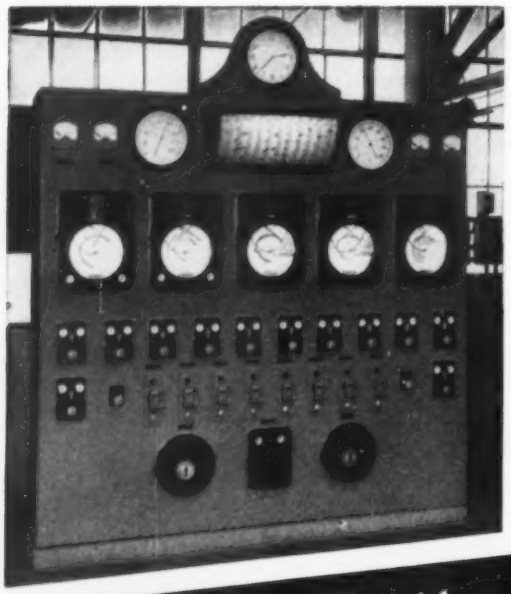
Completely coordinated in design, these modern generating units are manufactured, assembled and tested in one plant under unified supervision.

For a detailed story of the WA-Series features that can help you reduce costs, ask your A-C representative for Bulletin 03B7654, or write to Allis-Chalmers, Milwaukee 1, Wis.

A-4112

ALLIS-CHALMERS

A-C ALLIS-CHALMERS



This Bailey Boiler Control Panel in a mid-western industrial plant saves fuel and insures safe operation of a 100,000 lb per hr, 175 psi, sat., pulverized coal and gas-fired boiler.

What's Your Control-Dollar Efficiency?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better control-dollar efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-1

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

For more data circle 547 on Post Card

THE Amerigear* FULLY CROWNED TOOTH DESIGN

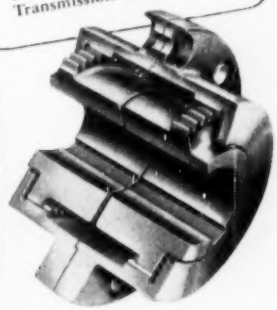
practically eliminates "End Tooth and Tip" contact . . . gives greater freedom of axial movement

Crowned Tip Contacts Root of Internal Gear Tooth in Sleeve, Accurately Piloting Sleeve with a Ball and Socket Action.
Chamfered to Eliminate Interference with Sleeve Tooth Fillet and Allow Contact on True Flank of Gear Tooth.
Crowned Flank Carries All the Load and Provides for Correction of Lateral and Angular Misalignment Conditions.
A MAJOR IMPROVEMENT IN GEARING

Pat. & Pat. Pending

Amerigear*

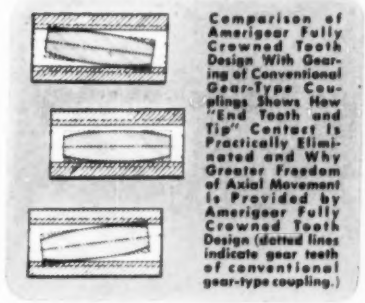
Fully Crowned Tooth Design Solves Wide Range of Power Transmission Problems.



Oil Seals of Amerigear Couplings Are As Advanced in Design, Performance, and Effectiveness As Is the Amerigear Fully Crowned Tooth.

This major improvement in gearing—a fundamental improvement in gear tooth design results in these advantages: (1) Relief from extraneous stresses; (2) Crowned flanks providing for angular and lateral misalignment with back lash reduced to a minimum; (3) Torque load carried on flanks of teeth rather than on tooth edges; (4) Greater loads and higher speeds with corresponding longer life for coupling and equipment; (5) Close fit on crowned tips and flanks of teeth, inducing a ball and socket action between hub teeth and internal sleeve teeth, assure quiet and smooth performance. These advantages distinguish the Amerigear Couplings from common gear-type couplings. If your problem arises from excessive offset or angular misalignment, tight back lash requirement, space limitations, high speeds and loads, or any combination of these, the best solution is assured by use of the Amerigear Couplings with the Fully Crowned Teeth. Amerigear Engineers are available for consultation.

*Trade Mark Reg.



Comparison of Amerigear Fully Crowned Tooth Design With Gearing of Conventional Gear-Type Couplings Shows How "End Tooth and Tip" Contact Is Practically Eliminated and Why Greater Freedom of Axial Movement Is Provided by Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling.)

Copyright 1953

AMERICAN FLEXIBLE COUPLING COMPANY

ERIE, PA., U. S. A. ***Originator of the Amerigear Fully Crowned Tooth***

Sales Offices in Principal Industrial Centers

In Canada: Canadian Zurn Engineering, Ltd. • 2052 St. Catherine St. W., Montreal 25, P. Q.

American Flexible Coupling Co., Erie, Pa., U. S. A.

Please send me further information regarding AMERIGEAR COUPLINGS with the Fully Crowned Teeth and Catalog No. 501.

Name *Title*

Company

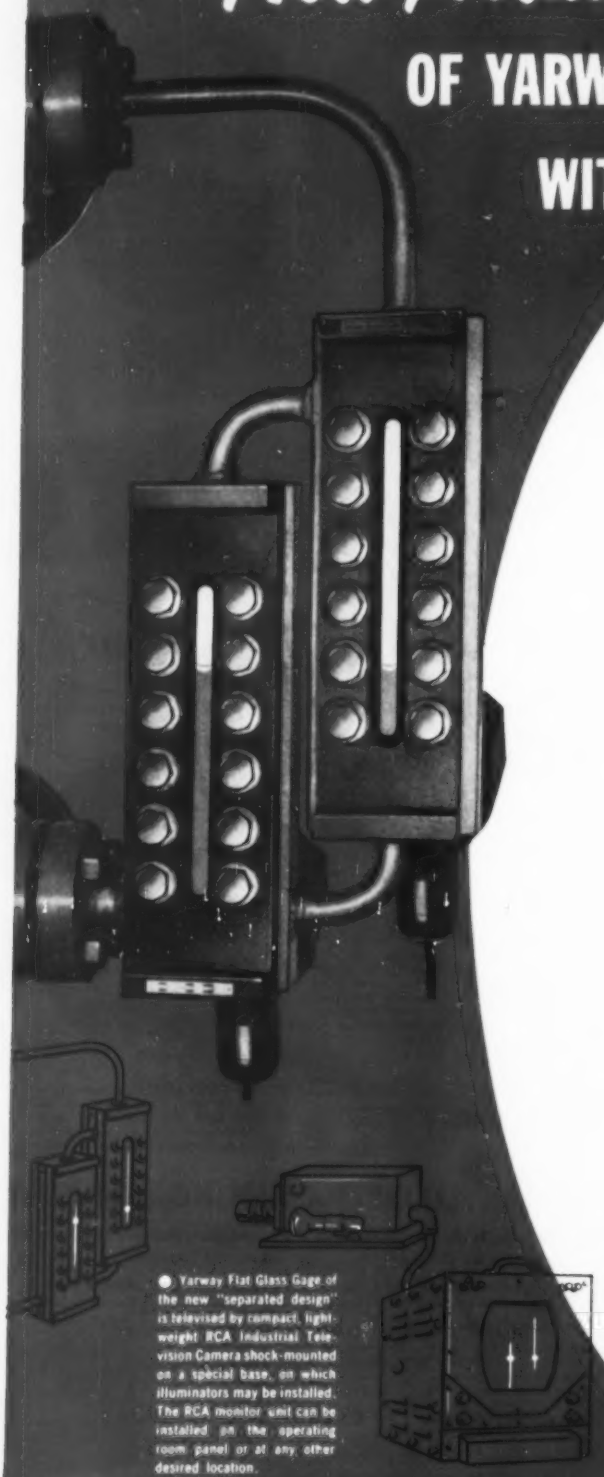
Address

City *State*

Please attach to your business letterhead.

For more data circle 514 on Post Card

Now Available... TELEVISION OF YARWAY FLAT GLASS GAGES WITH RCA INDUSTRIAL TV



● Yarway Flat Glass Gage of the new "separated design" is televised by compact, lightweight RCA Industrial Television Camera shock-mounted on a special base, on which illuminators may be installed. The RCA monitor unit can be installed on the operating room panel or at any other desired location.

RCA Industrial Television is now available for televising at a distance, boiler water level readings as indicated on Yarway Flat Glass Water Gages.

Yarway's broad experience in boiler water level indication, and RCA's leadership in the field of television, have been combined to give modern power plants "live" readings at any location in the plant.

This optional TV feature extends the already wide application of Yarway Gages in the steam power field. It is another of recent Yarway developments aimed at more accurate, more dependable, less costly water gage service.

Such features as the new *separated design with interconnecting expansion loops, Type "M" Illuminator* that causes the meniscus to shine like a star, the use of *tie-bar-type water columns, Yarway Welbond gage valves,* and *Yarway Pressure-sealed "floating assembly" gage glass inserts* make Yarway gages the modern gages for modern plants.

Your Yarway engineer will be glad to tell you about the new television feature, as well as the other Yarway advantages, or if you'd rather first have a descriptive bulletin, ask for Bulletin WG-1813.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

For more data circle 516 on Post Card

RCA Industrial TV

PRECISION INSTRUMENTATION FOR THE POWER FIELD

For precise reproduction of remote readings—for easy viewing of operations that are now too difficult to watch—RCA introduces sharp-focus, high-definition industrial television.

The RCA Vidicon camera tube packs a maximum of image resolution into its lightweight, heavy-duty TV chain. The Vidicon tube—only 6" long by 1" in diameter—operates on the same scanning principal as commercial television—provides a clear, crisp picture that you can trust for accuracy.

FITS ANYWHERE—OPERATES ANYWHERE

Because of its small size—because there are only two units in a complete RCA Industrial TV chain—RCA Industrial TV can be used practically anywhere.

Typical power applications for RCA Industrial Television include: remote viewing of water level gages and meters; observation of internal furnace conditions; and smoke control.

- The following field-tested accessories—

Furnace water-cooled lenses	Outdoor weather-proofed housings
Automatic iris control	Remote panning
Shock-proof mounts	Industrial auxiliary viewers

—make RCA Industrial TV practicable indoors or outdoors in high or low ambient temperatures.

FOR INFORMATION write RCA Engineering Products Dept., Camden, New Jersey.

● RCA Industrial TV monitor can be panel-mounted. Single cable connects monitor to camera. Power supply—110 volts, 60-cycle AC.

● RCA Industrial TV Camera weighs only 7½ pounds, measures 3" x 5" x 10". Once camera is set in place, all adjustments can be made from face of monitor.

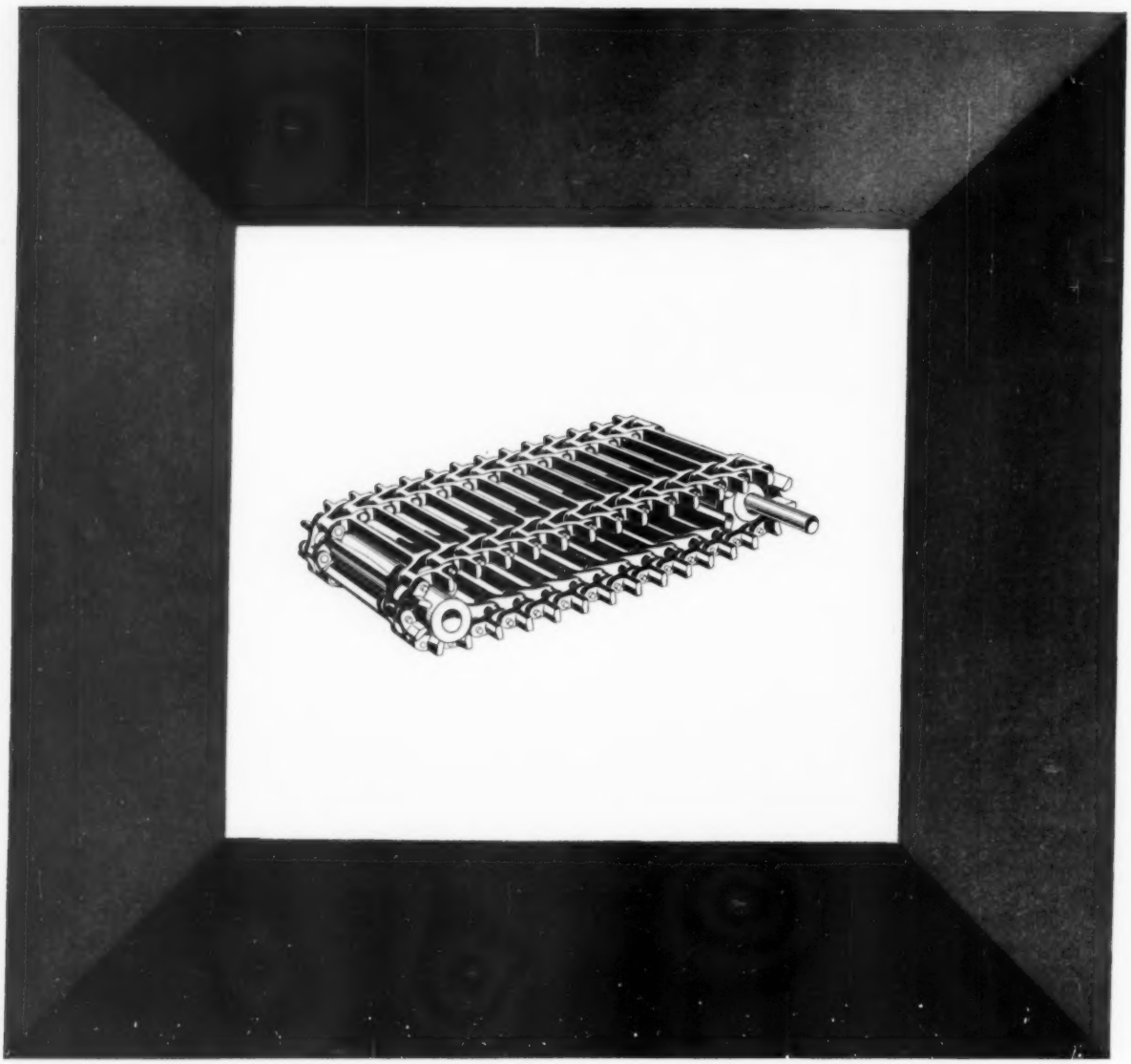
Industrial Products

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

For more data circle 517 on Post Card



The secret of no-clog feed for Perfect Spread

PERFECT SPREAD is the only STOKER available today that never clogs... not even on wet coal! And the secret of this remarkable efficiency is the exclusive American Engineering traveling conveyor feeder, pictured above, which employs a high traction principle and assures true, *continuous* feeding throughout its operating range of 50 to 7500 lbs. of coal per hour.

But in addition to no-clog feed, Perfect Spread Stoker gives you every other important feature... the special high-capacity spiral overthrow rotor which spreads coal over the whole grate so perfectly that it furnishes the stoker's name... the engineered cinder return and overfire air system that yield comparable results with both low and high ash coals.

Perfect Spread Stokers are made in a wide choice of sizes, capacities and grate types. Whether you are considering a new unit or restokering an old one, talk things over with your AE representative. It may lead to most steam at least cost.

AE

AMERICAN ENGINEERING

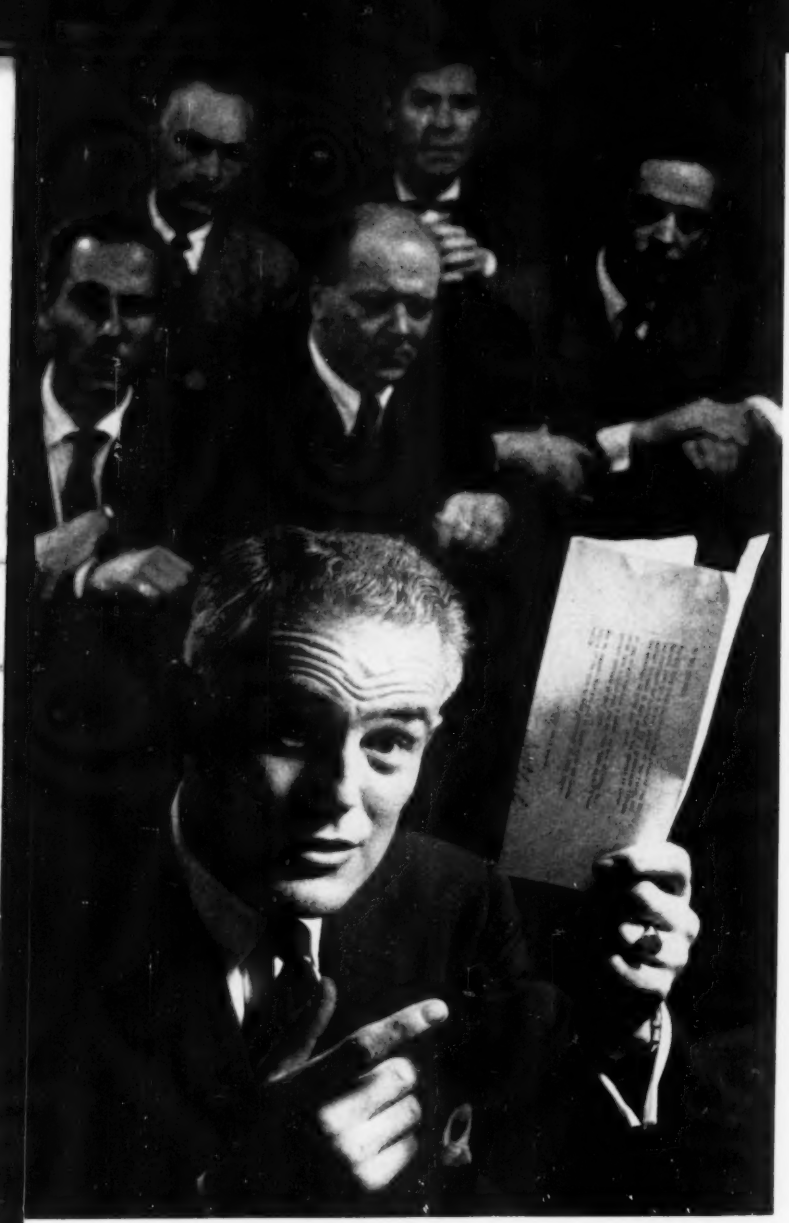
COMPANY

2408 ARAMINGO AVE., PHILADELPHIA 25, PA.

IN CANADA: AFFILIATED ENGINEERING CORPORATIONS, LTD., MONTREAL 2, CANADA

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

For more data circle 518 on Post Card



PRESSURE SEAL GATE VALVE *(Fig. 19003)*. 900-pound. Many proven advantages and exclusive features. Pressure Seal valves are available in Non-Return, Check, Globe and Angle Patterns.

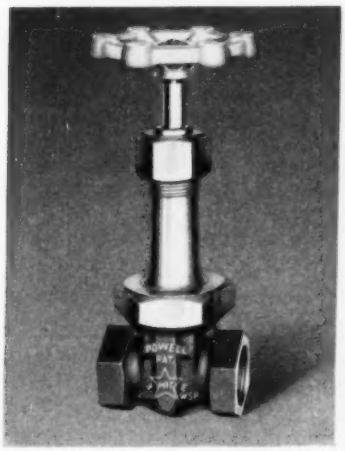
AN OPEN AND SHUT CASE

All the evidence is in. Powell Valves have a record of dependability since 1846. Powell makes more types of valves, has probably done more valve research and solved more valve problems than any other organization in the world.

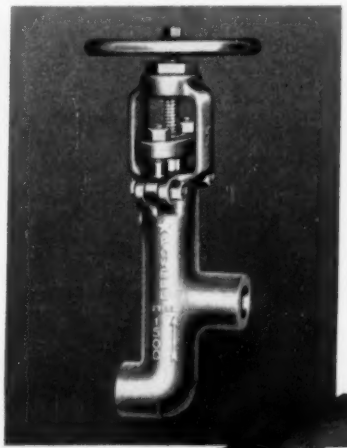
On the basis of such overwhelming evidence, can your verdict be anything but a decision in favor of Powell Valves? See exhibits following.

SWING CHECK VALVE *(Fig. 559)* for 125-pounds W.S.P. Iron body, bronze mounted. Regrindable, renewable bronze seat and disc. Sizes 2" to 16", inclusive.

BRONZE "WHITE STAR" GATE VALVE *(Fig. 375)* for 200 pounds W.S.P. Union Bonnet with inside screw rising stem. Renewable "Powellium" Nickel-Bronze wedge.



INTEGRAL BONNET OFFSET GLOBE VALVE *(Fig. 1331-A)*. 1500-pound. One-piece construction eliminates possibility of leakage between body and bonnet. Sizes ½" to 2", inclusive.



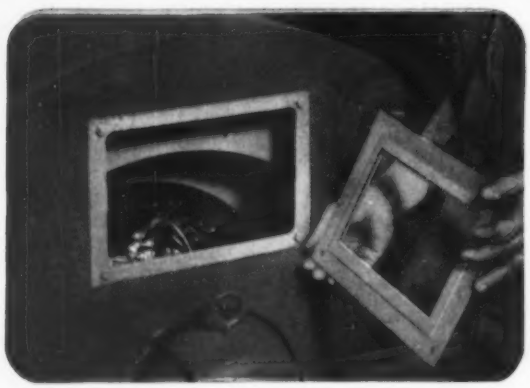
DEPENDABLE VALVES SINCE 1846

Powell Valves

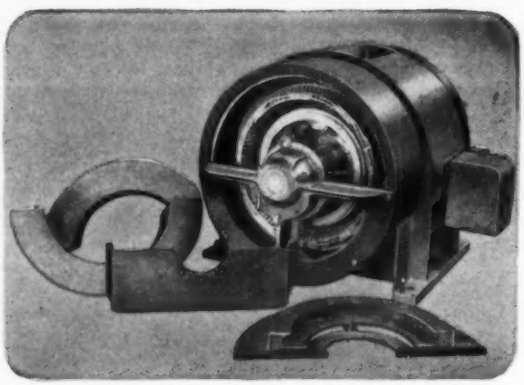
THE WM. POWELL COMPANY • CINCINNATI 22, OHIO

For more data circle 519 on Post Card

Below is a typical forced-ventilated installation. Motor can be arranged so ducts can be brought in at any angle.



Lucite window makes brush inspection easy. Simply remove window for quick entrance to brushes . . . for checking and inspection and maintenance.



Light, sturdy end covers and air shields are easily and quickly removed for inspection and cleaning. No crane is required. One man can do the job easily.

MORE POWER PER DOLLAR

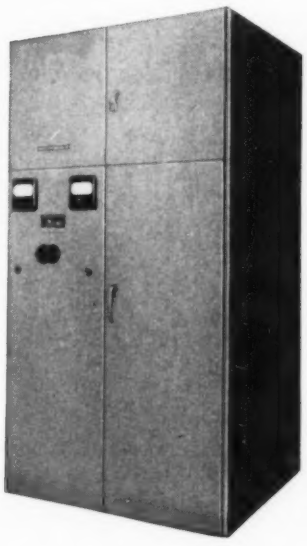
Synchronous Motor Offers New Installation Flexibility

When forced ventilation is required you can eliminate many installation problems with this synchronous motor. Air is supplied to the motor from both ends through air inlet brackets . . . two at each end, on either side. Duct or pipe connections can be brought from above . . . from below . . . from one side or the other . . . or a combination. Thus, you can position the motor without regard for duct work.

Covers and air shields, too, add to installation flexibility. They can be easily removed — by hand — for inspection or cleaning of the motor. No crane is required. Thus motors can be mounted in hard-to-reach places.

This added installation flexibility may open up new opportunities to save money with synchronous motors. In many cases, these motors will improve your power factor and reduce your power bill. They provide more power per dollar for many types of drives than any other motor.

Get all the facts on Westinghouse Synchronous Motor savings. Ask your Westinghouse representative for information on the simplified inspection and servicing these motors offer. Complete information is available. Ask him for a copy of DB-3200 or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10354-A



YOU CAN BE SURE...IF IT'S Westinghouse

Matched control for the motor. This Slipsyn Synchronous Motor Control protects your motor investment . . . helps you get more for your power dollar.

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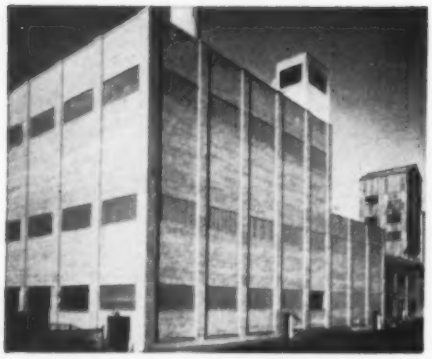


THE AMALGAMATED SUGAR COMPANY, Rupert, Idaho
One 150,000 pound Detroit RotoGrate Stoker

THE AMALGAMATED SUGAR COMPANY, Nyssa, Oregon
Three 90,000 pound Detroit RotoGrate Stokers

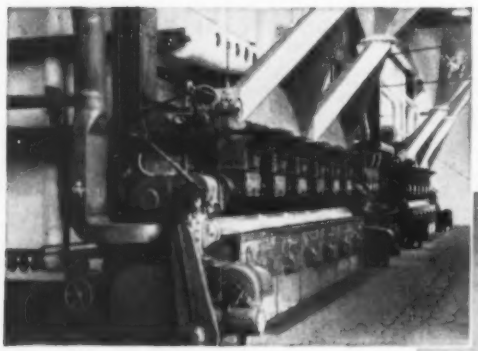
Detroit Stokers Burn Coal EFFICIENTLY in Many Food Product Plants

Repeat order customers are the best evidence of satisfactory performance of Detroit RotoGrate Stokers and Detroit RotoStokers—spreader stokers that burn a portion of the fuel in suspension—the balance on grates of special design.

They Provide These Features You Need In A Stoker:

- Burn any Bituminous Coal or Lignite without special preparation.
- Increase capacities due to higher burning rates.
- Provide exceptional fuel economy.
- Are exceedingly responsive to fluctuating loads.
- Operate with low auxiliary power.
- Coal feed and air supply are automatically controlled.
- Operate with preheated air if desired.
- Availability high . . . Maintenance low.

Do you need more steam? If so, investigate and order your Detroit Stokers now. Write for Bulletin—No Obligation

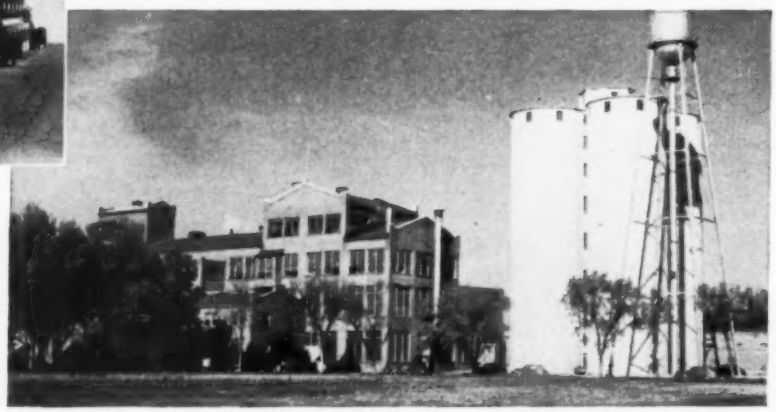


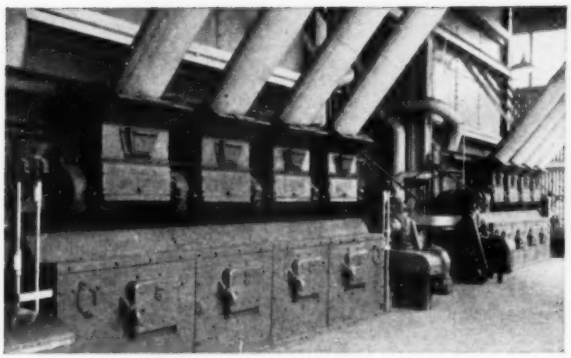
GREAT WESTERN SUGAR COMPANY,
Fort Morgan, Colorado
Two 102,500 pound
Detroit RotoGrate Stokers

DETROIT STOKER COMPANY

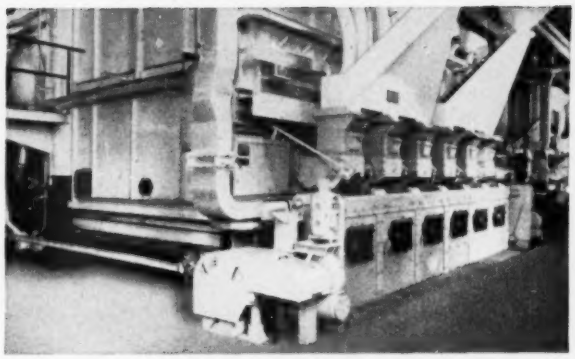
GENERAL MOTORS BLDG., DETROIT 2, MICH.

District offices in Principal Cities • Works in Monroe, Mich.





UTAH IDAHO SUGAR COMPANY, Garland, Utah
Two 100,000 pound Detroit RotoGrate Stokers



GREAT WESTERN SUGAR COMPANY, Longmont, Colorado
Two 150,000 pound Detroit RotoGrate Stokers

★Repeat Order Plants

★Amalgamated Sugar Company
★American Crystal Sugar Company
★Armour & Company
★Borden Company
California Packing Corporation
Campbell Soup Company
The Capital City Products Company
★Central Soya Company, Inc.
W. N. Clark Company
★Clinton Industries, Inc.
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Cudahy Brothers Company
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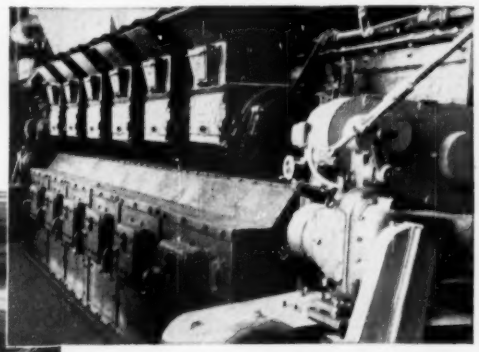
★Great Lakes Sugar Company
★Great Western Sugar Company
Gunnison Sugar, Inc.
Hawaiian Commercial & Sugar Co. Ltd.
★Illinois Meat Company
★International Salt Company
★The Keever Starch Company
Lake Shore Sugar Company
★Libby, McNeill & Libby
Manistee Salt Works
★Oscar Mayer & Company
Menominee Sugar Company
★Michigan Sugar Company
Monitor Sugar Company
Morton Salt Company
National Fruit Products Company
National Oats Company
★National Starch Products, Inc.
National Sugar Manufacturing Company
★G. M. Peet Packing Company
★Planters Nut & Chocolate Company
Quaker Oats Company
★Ralston Purina Company
★The Rath Packing Company
Russell Miller Milling Company
J. R. Short Milling Company
★Stokely Foods, Inc.
Sugardale Provision Company
★G. S. Suppiger Company
★Swift & Company
Tobin Packing Company, Inc.
★Utah-Idaho Sugar Company
Vincennes Packing Company
Western Grocer Company
★Wilson & Company, Inc.

There is a type and size of Detroit Stoker for every Industrial need.

DETROIT SINCE 1898 STOKERS



AMERICAN CRYSTAL SUGAR COMPANY,
Moorhead, Minnesota
Two 90,000 pound Detroit
RotoGrate Stokers

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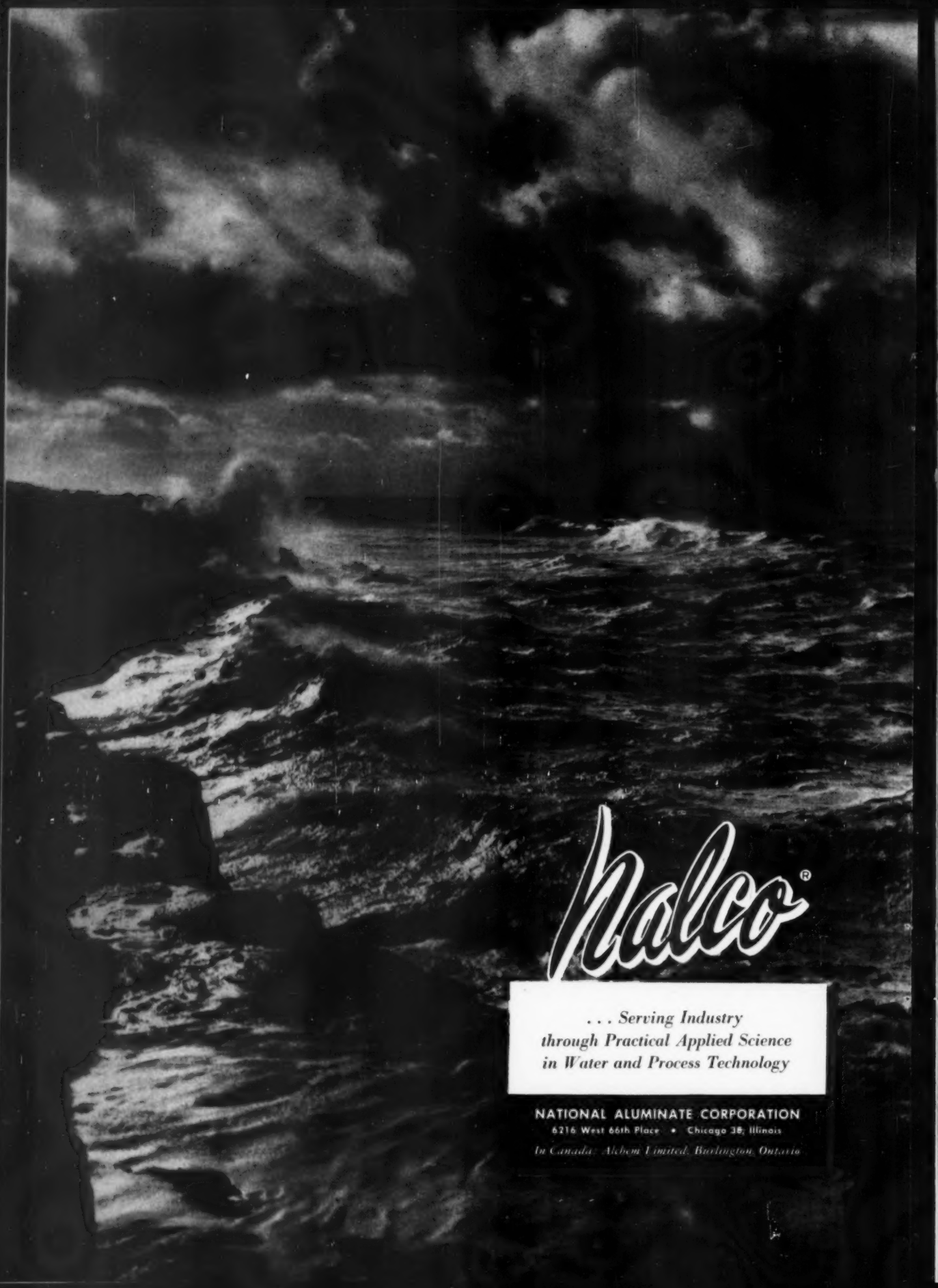
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through Practical Applied Science
in Water and Process Technology
NATIONAL ALUMINATE CORPORATION
6216 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. Circle item numbers of all catalogs wanted on the postage-free card below, detach and mail

ENGINES

101 Diesel Design Features — Here's a 48-pp booklet giving detailed descriptions of engineering design features to look for in diesel engines. In addition, ratings and descriptions of manufacturers diesel models are presented. Some 19 pp are devoted to photos of typical installations. Murphy Diesel Co.

102 Gasoline Engines — Horisontal and vertical models of gasoline engines in a variety of applications and models are discussed in Bulletin L-7696, 6 pp. Photos, cutaway and section views, horsepower and torque curves, dimensional drawings, and condensed specifications illustrate bulletin. Fageol Products Co.

MECHANICAL POWER

103 Stock Chains, Sprockets — Sixteen-pp Catalog 753 describes, pictures and lists "from stock" roller chains of various pitch sizes, finished bore sprockets with keyways and setscrews in over 75 tooth sizes and more than 280 bores, and medium and large sprockets having taper lock bushings to provide off-the-shelf service with any required bore. The tabular matter covers speed ratios for various sprocket combinations and chain technical data. Diamond Chain Co., Inc.

104 Packaged Drive — Booklet B-5808, 16 pp, about packaged adjustable-voltage drives, their construction, operation, typical applications, and economies of operation. Special operational characteristics that can be added to the standard package are described, such as inching, reversing, dynamic braking, multi-motor control. Westinghouse Electric Corp.

105 Friction Clutch Data — Form 831–53 is an illustrated engineering data sheet covering torque-limiting slip type friction clutches designed to provide overload protection for machine drives by functioning as an automatic shear pin mechanism. Includes dimensions and capacities of standard 4½-, 5½- and 6½-in. dia adjustable clutches, also data on roller chain sprockets. Morse Chain Co.

BOILERS AND AUXILIARIES

106 Scotch Boilers — Catalog 98, 6 pp, describes Scotch boilers for high and low pressures, designed for oil or gas firing, and suited for use with oil, gas or combination burners. Provides ratings, dimensions. Kewanee-Ross Corp.

107 Boiler-Burner Unit — Sixteen-pp Bulletin B-3133 introduces a boiler-burner unit designed for oil, gas or combination firing, for high, or low pressure heating, power and process steam. Illustrated in color, booklet stresses efficiency of the unit, describes features and provides ratings, data and dimensions. Iron-Fireman Mfg. Co.

108 Packaged Fuel Oil Units — Eight-pp Bulletin 16-H shows how these new units for pumping, heating and straining of fuel oils are designed to provide an efficient and economical means of supplying Bunker C or other grades of fuel to the oil burners. Control and service valves, pumps, heaters and strainers are discussed and a typical elevation assembly is illustrated. Schutte and Koerting Co.

109 Heavy-Oil Burners — Bulletin 175-G, 8 pp, covers an extended line of belt-driven, horizontal, rotary-type burners of 12 to 175 gal capacities. Describes outstanding design and construction features of both oil and oil-gas units. An equalising valve, optional with these burners, is also presented, along with discussion of conditions under which it is of value in improving combustion and reducing noise. Complete specifications included. Preferred Utilities Mfg. Corp.

ELECTRICAL

110 Small Motor Service Plan — Bulletin GEC-972, describes company's motor service plan for fractional- and integral-hp motors and generators; warranties, motors covered by the plan, and fhp motor factory repair service. Service stations are listed. General Electric Co.

111 Vertical Pump Motors — Bulletin 1250, 8 pp. covers a line of hollow and solid shaft vertical pump motors. Shows various types of enclosures available for these units and illustrates many varied uses. Cutaway illustrations and phantom drawings, some in color, also show details of the non-reverse ratchet, thrust-bearings available. The Louis Allis Co.

112 Power-Line Carrier — New carrier equipment is described in Booklet 84-000, 16 pp. Assemblies for relaying, telemetering, supervisory control, remote control, and other service are described, with photos of the assemblies. Also discusses features such as crystal control, selectivity. Westinghouse Electric Corp.

113 Electrical Distribution — Bulletin BD-755, 16-pp, describes construction features, installation and adaptations of manufacturer's system of electrical distribution. Gives examples showing how the plug-in fittings simplify installation. Also gives ratings and specifications and contains diagrams showing difference between centralised and decentralised systems. BullDog Electric Products Co.

114 Self-Supporting Aerial Cable — Eight-pp Bulletin OK-1064 provides physical and electrical characteristics of self-supporting aerial cables with aluminum conductors. Dimensional information and current carrying capacity tables are included. The Okonite Co.

115 Circuit Breaker — Bulletin 71B7946 gives construction features, ratings, dimensions and weights of power oil circuit breakers designed for outdoor distribution service, and is available with automatic reclosing relay equipment. Allis-Chalmers Manufacturing Co.

116 Modernized Disconnect Switch — Publication 5305, 6 pp, presents the new version of company's

OCTOBER, 1953
Card void in 6 months

POWER ENGINEERING

Please have the manufacturer send me without obligation information or bulletins indicated by the numbers circled below.

Name..... Title .....

Company Name .....

Company Address .....

City..... State.....
(If you prefer delivery at home, give home address, too)

Home Address.....

City..... State.....

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Use this space to ask for tear sheets and other information. .....

PMB-236 disconnecting switch for group operation. Discusses and pictures new features of this low cost, single horizontal break switch, known for its compactness and ease of operation. Complete listings and dimensions for the new switches are given for standard voltage ratings. Delta-Star Electric Div., H. K. Porter Co., Inc.

117 Group Lamp Replacement — This 10-pp booklet, "Group Lamp Replacement Pays Off," is an illustrated case history report on group lamp replacement plans. Recommends two methods, one based on replacement when lamps have burned a fixed percentage of their rated life; and the other, on replacement when lighting drops to an established minimum level. Such benefits as lower labor costs, longer performance of auxiliary equipment, lower accident rates, higher lighting levels etc. are discussed. Lamp Div. General Electric Co.

WATER TREATING

118 Water Conditioner — Eight-pp Bulletin 3660 describes company's package water conditioning plant as a versatile and self-contained unit which chlorinates, coagulates, clarifies, filters, neutralizes, de-alkalizes and softens raw water supplies. Lists component parts of the unit and explains principles of operation. Gives ratings, capacities and sizes. Typical installations are shown. The Permutit Co.

119 Mixed-Bed Demineralization — Bulletin 126 explains in text and pictures how a mixed-bed demineraliser operates in producing high-purity water by ion-exchange method. Stresses company's simplified positive regeneration system which separates resins quickly and remixes them. Barnstead Still & Sterliser Co.

. . . Outstanding Among This Month's Catalogs

120 Industrial Combustion Data — The new 168-pp third edition of this handbook provides a wealth of information on industrial heat processing, and is of special interest to those concerned with the selection, supervision, operation and maintenance of oil and gas combustion equipment. Presenting this information in concise, practical form, book includes sections devoted to general industrial heating data, oil burning, gas burning, oil-burning equipment and gas-burning equipment. Illustrated, also provides definitions of technical terminology. Available to qualified power engineers. Please state your job title when requesting this book. Hauck Mfg. Co.

121 Cable Accessories — More complete than previous editions this new catalog of cable accessories offers approximately 170 pp of practical help to power engineers who buy, specify or install cable accessories. It's a combination of two sections from company's general catalog — those covering potheads and terminals and accessories for wire and cable. The latter section tells all about making joints; it provides drawings of 45 different designs, and covers joints, connectors, rolling tools, tie wire, armor rods, and allied items. Well illustrated, this book presents data simply, is fully indexed. Please state your job title when requesting this. Anaconda Wire & Cable Co.

INSTRUMENTS AND CONTROLS

123 Index to Instrument Literature — Bulletin 200-B is a complete index to company's Instrumentation Magazine. Contains a list of volumes and numbers published from 1943 through 1952, an alphabetical index of articles by subject, and an alphabetical listing of companies and institutions about which articles have been published. Minneapolis-Honeywell Regulator Co.

124 Boiler Feed Control — Bulletin 1013 illustrates and describes an instrument-type feedwater control system with feed to the boiler modulated by: steam flow, feed-water flow and drum water level. A block diagram illustrates operation of the control, and photos show instruments and units making up the system. Copes-Vulcan Div., Continental Foundry & Machine Co.

125 For Boiler Blow-Off — This 8-pp bulletin describes company's orifice meter, a flow control unit for boiler blow-off. Discusses boiler blow-off, explaining where trouble starts and how the orifice meter offers a solution. Also explains engineering and operating principles of the unit. The Madden Corp.

126 Orifice Meters — Bulletin 1050 Rev 1, 28 pp, shows how manufacturer's orifice meters are made and how they operate. Tables give capacity data, and there are descriptions of manifold arrangements and differential ranges, along with illustrations of various parts. Sketches show how the meters are used with liquid seal chambers and piping for steam, corrosive gases and liquids. Specifications are provided, also general instructions for meter servicing. Rockwell Mfg. Co.

127 Pyrometer Ordering Book — A wide range of pyrometer supplies is illustrated and described in the newly-revised Buyers Guide 100-S, 50 pp. All general thermocouple assemblies and components are listed, as well as many special purpose units. Prices and information on the selection, care, and application of thermocouples are included. Industrial Div., Minneapolis-Honeywell Regulator Co.

The Reader Service Card at left needs no postage. Just circle item numbers of all bulletins wanted, fill in name, company, detach and mail

128 Unit Regulator — Eight-pp Bulletin 155 describes manufacturer's unit regulator, a self-contained hydraulic controller engineered for automatic pressure, flow and proportioning control. Specifications are listed, and schematic drawings show applications. A cut-away drawing shows component parts and design features. Askania Regulator Co.

130 Central Control Panels — The use of this manufacturer's Panelgraphs in a broad range of industrial control applications is shown in Bulletin PI-153. These panels utilize visual aid techniques to present process information, enabling the operator to comprehend large masses of data and keep process functioning properly. Shows installations in power stations,

(*Continued on page 135*)

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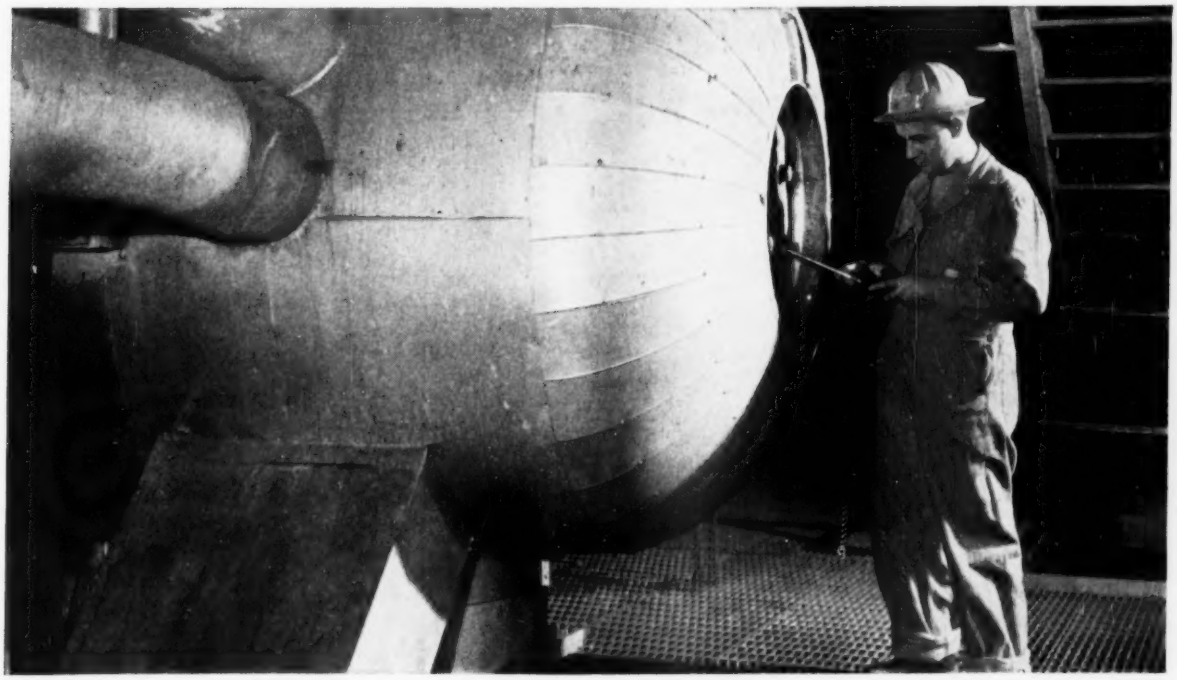
CHEMICAL CLEANING PROVED MORE EFFECTIVE IN BOILER TEST

DOWELL method showed greater efficiency by 4.5% in utility company comparison



Perhaps the most convincing way of demonstrating the advantages of one method of cleaning over another is to conduct a comparative test.

That's exactly what one of the larger utility companies did to compare chemical cleaning with mechanical cleaning. The 23-day test was conducted with companion boilers, rated at 200,000 lb. per hour operating at 500 p.s.i. One boiler was chemically cleaned by Dowell, the other was turbined.

At the conclusion of the test, the boiler which was chemically cleaned by Dowell had a 4.5% greater efficiency factor with a saving of 0.1 lb. of coal for every pound consumed per KWH gross. With results like this to cite, it's no wonder leading plants in all parts of the country rely on Dowell service for their maintenance cleaning.

Dowell engineers do the job for you, using liquid solvents which are brought to your plant in truck-mounted tanks along with all necessary pumps and control equipment. No special scaffolding is required. Dismantling and down-time are kept to a minimum; equipment can often be cleaned while in operation.

For complete information and estimates on cleaning your equipment, call the nearest Dowell office, or write directly to Tulsa, Dept. J-24.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED · TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

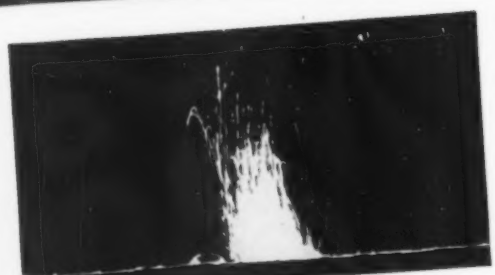
For more data circle 523 on Post Card

How Dearborn Helps

with FILMEEN for the control of return line corrosion

Dearborn's patented FILMEEN—a filming-type amine treatment—forms a continuous monomolecular film in the return line, thus effectively coating and protecting the line against both oxygen and carbon dioxide corrosion. Improves heat transfer and reduces steam costs.

Bulletin 5013-A gives complete information on FILMEEN—describes and illustrates how to reduce maintenance expense and protect valuable equipment.



Formula 659 Prevents Foaming

Boilers, feed lines, heaters and economizers are protected against sludge accumulations—steam purity control is assured—turbine deposits are effectively prevented—with Dearborn's Formula 659 Sludge Conditioner and Polyamide Anti-Foam Treatment. Safeguards against carry-over of suspended and dissolved solids. Protects valuable parts—avoids expensive maintenance and unnecessary shutdowns. Bulletin 5008 tells the complete story.

Dearborn

TRADE MARK

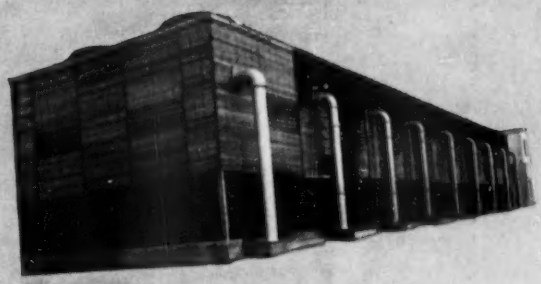
COMBATTING CORROSION EVERYWHERE SINCE 1887

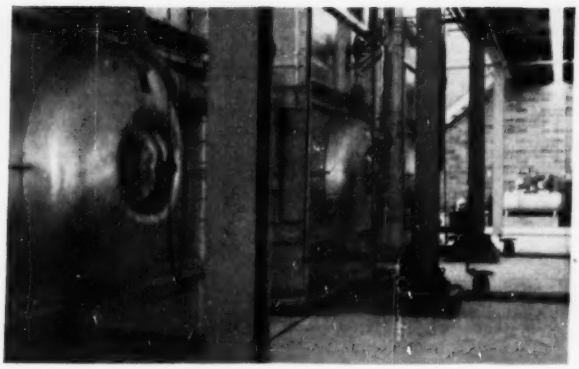
DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois

Make Water Behave!

COOLING WATER for testing jet aircraft engines is treated by DEARBORN

Here is one of the giant 500,000 gallon cooling water towers operated by the National Advisory Committee for Aeronautics. To prevent scale formation, corrosion and delignification of the wood, properly conditioned water was necessary. Dearborn engineers did the job... analyzed the raw water, and specified the correct treatment, test equipment and controls.



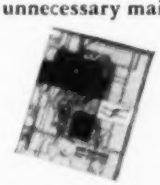


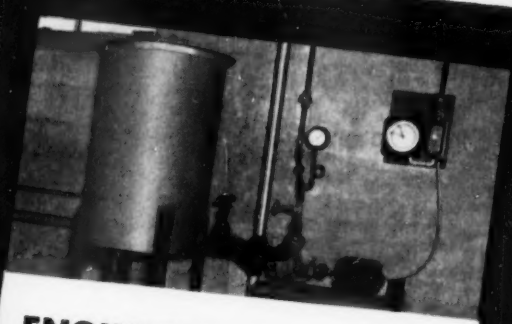
with DEARBORN'S complete water treatment and engineering service

Providing trouble-free water—a vital necessity to every user of steam—has been Dearborn's business for more than 65 years.

Today, this broad background of experience—plus treatment formulas that have been tested and re-tested and the most modern laboratory and research facilities—is available to you at Dearborn.

To keep your power and steam-producing facilities at peak production... to greatly minimize unnecessary maintenance—call your Dearborn Sales Engineer. He's our expert who will check your facilities—analyze your raw water—recommend the proper treatment, feeding equipment and test procedure. Dearborn Bulletin 5000 describes this service.





ENGINEERED equipment

For optimum water conditioning, proper equipment is essential. Here, too, Dearborn can help you. The complete line of Dearborn ion-exchange and treatment feeding equipment, plus test control facilities, will provide you with assurance of top operating efficiency.

Dearborn Chemical Company — Dept. PG
Merchandise Mart Plaza, Chicago 54, Illinois

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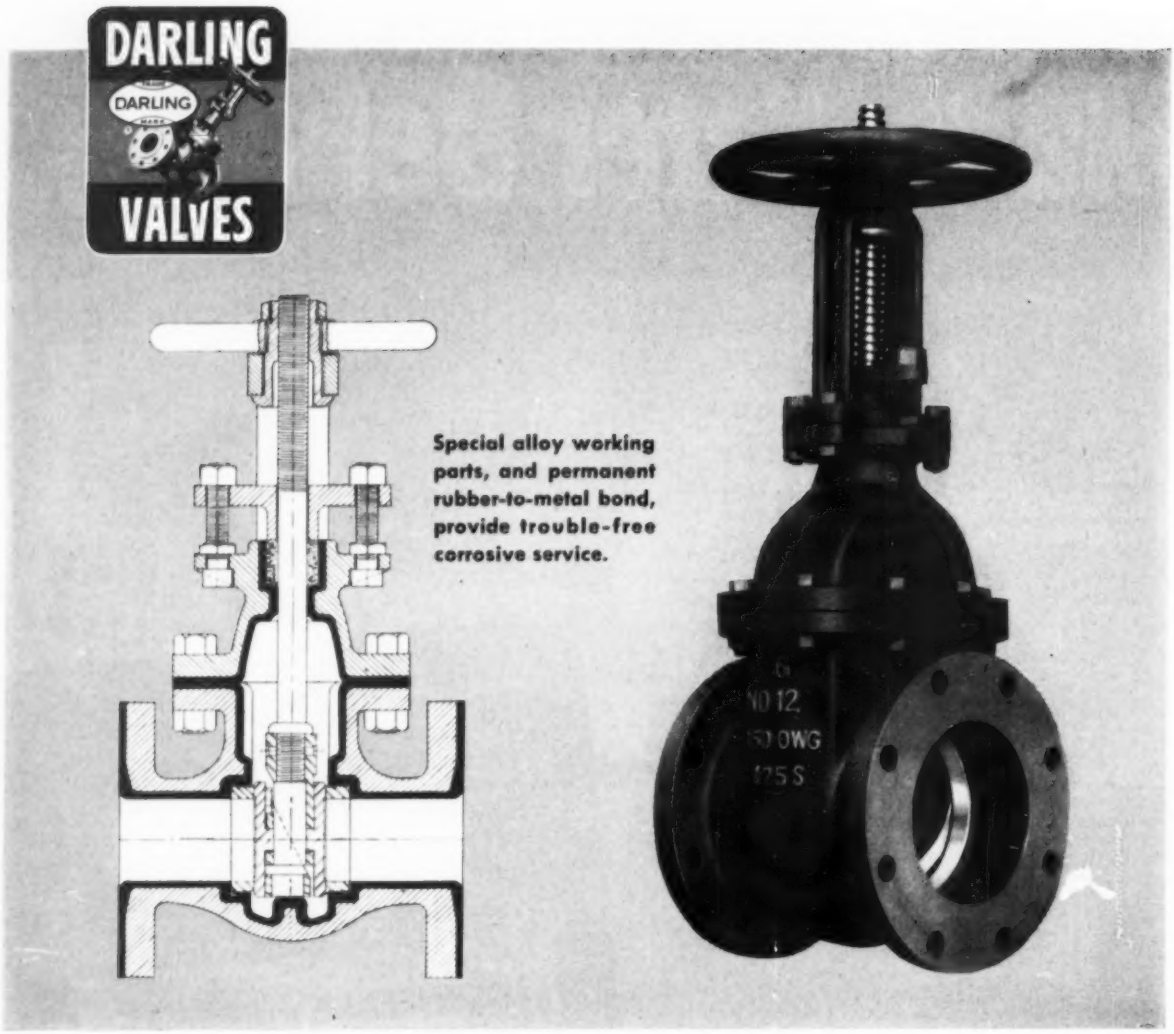


Meeting the "Acid Test" the low-cost way with DARLING rubber lined iron body valves!

YOU can save dollars by installing Darling rubber lined, iron body gate valves for corrosive services up to 150°F. These Darling gate valves are giving outstanding service in job after job.

You Get This Plus Value Too!

The *fully revolving double disc,* parallel seat principle compensates automatically for valve body distortion. Tight closure is assured every time. And wear on working parts is *uniform.*

In plant after plant Darling rubber lined, revolving disc, parallel seat gate valves are setting records of efficiency and economy. These unique rubber lined valves are made in rising stem, cylinder, motor-operated, or quick-opening types. Ask for the special Darling rubber lined *gate* and *check* valve bulletin.

VALVES FOR EVERY NEED

Darling also offers gate valves in a wide range of sizes, types and construction for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

DARLING VALVE & MANUFACTURING CO.

Williamsport 19, Pa.

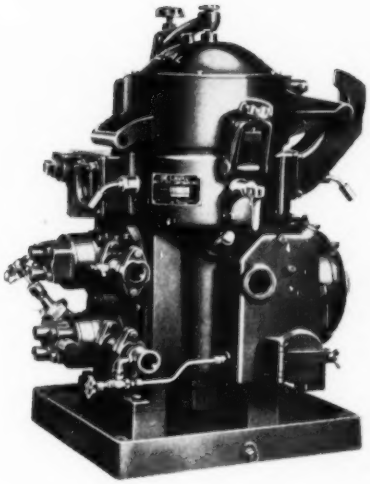
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt, 19, Ontario

For more data circle 525 on Post Card

NO GETTING AROUND IT

DE LAVAL OIL PURIFIERS STOP TROUBLE BEFORE IT STARTS

De Laval Centrifugal Oil Purifiers remove ***both*** of the chief causes of lubricating oil deterioration —dirt and water. They are positive insurance against the trouble that impure lubricating oil can cause.



A De Laval Oil Purifier does its job thoroughly. Water is discharged continuously after being removed from the oil by centrifugal force, and the dirt is stored in the bowl, outside the zone where purification takes place.

De Laval Oil Purifiers have another important advantage — they have enough reserve capacity to take care of a sudden emergency, such as a surge of water due to a leak.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

De Laval

LUBRICATING OIL PURIFIERS

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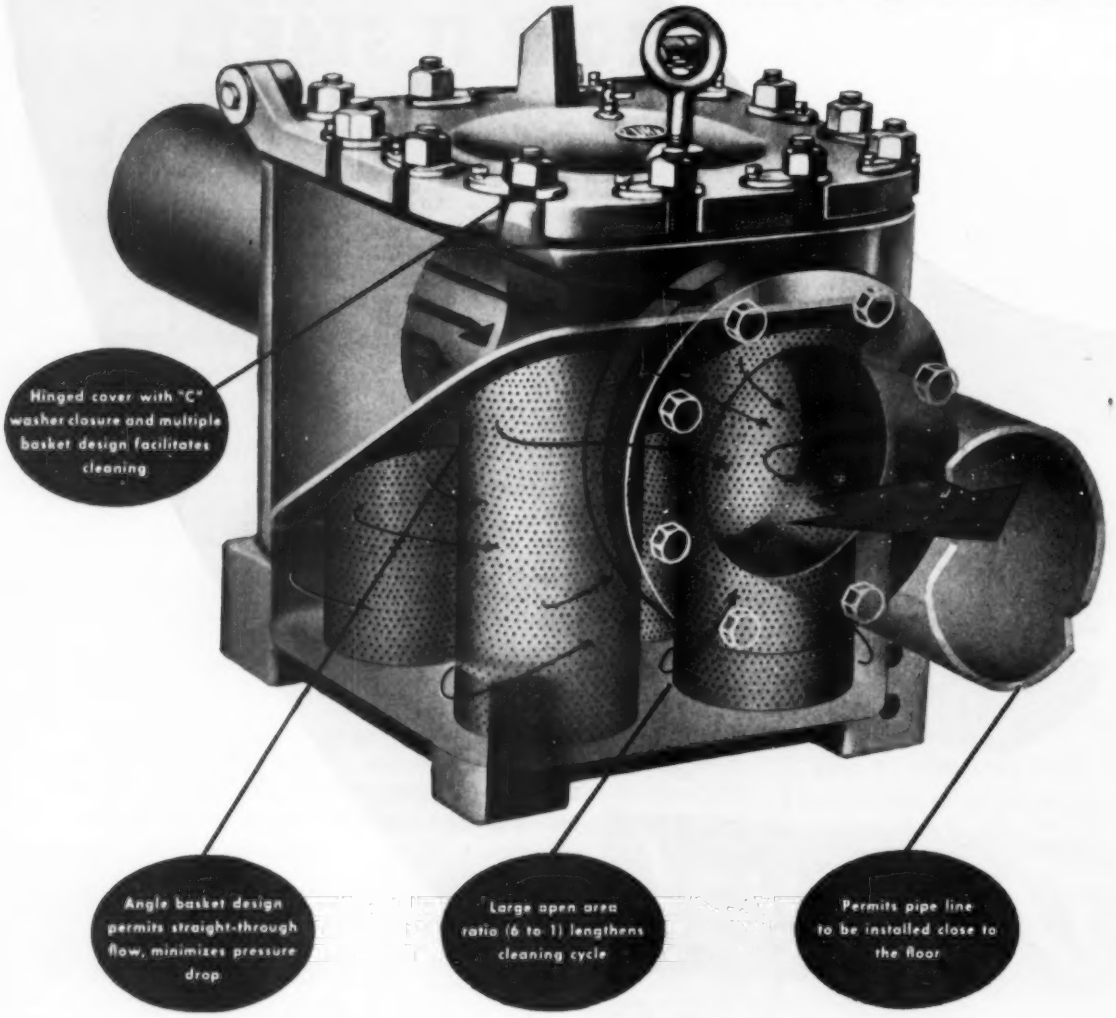
LONGER INTERVALS

ZURN **SINLEX MULTIPLE BASKET**

Zurn LPD Strainers permit high rates of flow with remarkably low pressure drop. They provide continuous flow of liquids, immeasurably improving the handling of fluids such as oil, chemicals, water, through pipe lines. They provide the utmost protection from costly shut downs.

L-P-D STRAINERS *permit one-man operation— reduce operating cost*


Hinged cover with "C" washer closure and multiple basket design facilitates cleaning
Angle basket design permits straight-through flow, minimizes pressure drop
Large open area ratio (6 to 1) lengthens cleaning cycle
Permits pipe line to be installed close to the floor

BETWEEN BASKET CLEANING

provided by large open area ratio of

ZURN

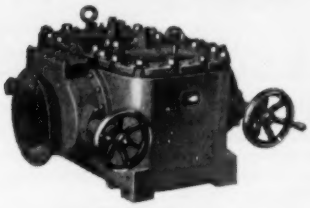
SINLEX MULTIPLE BASKET

LOW PRESSURE DROP STRAINERS

The angle basket design of this strainer is typical of how Zurn Low Pressure Drop (LPD) Strainers have been design improved for correct circularity. This angle type Multiple Basket Strainer permits straight-through flow, minimizing the pressure drop and insures complete retention of strained particles when basket is being removed for cleaning. A feature of this strainer is the small space required for its installation. It permits pipe line to be installed close to the floor. It has ample waterways, smooth inner walls, correctly sized and perforated baskets, and affords maximum protection for all types of mechanical units connected with pipe lines. Zurn LPD Strainers are held to close tolerances for materials, shapes, and dimensions, assuring the utmost in strength and factors of greater safety essential to continuous operation.

Zurn LPD Strainers are widely used to protect close tolerance control devices and delicate mechanisms, also to protect product purity. Their large open area ratio (6 to 1) lengthens intervals between need for cleaning baskets. Zurn Fluid Handling Engineers are available for consultation on your particular fluid handling problem.

There is a ZURN LPD Strainer for every fluid handling purpose



Zurn LPD Duplex Multiple Basket Strainer, Gate-Type.

Zurn LPD "Y" Type Strainer, available in any cast material and for high pressures.

Zurn LPD Sinlex Strainer, available in offset and straight-through types.

Zurn LPD Duplex Multiple Basket Strainer, Plug-Type.

Zurn LPD Strainer applications include fluid handling lines for lubricating and fuel oil, and oil during the refining process; a wide range of chemicals produced and used by the various process industries; public utility power plants; power stations; industrial plants; ships and high temperature installations. Zurn Fluid Handling Engineers are available for consultation.

WRITE FOR ZURN LPD STRAINER DATA MANUAL NO. 952 →

This Manual includes previously unpublished pressure drop data and gives useful, factual information on fluid handling.

Zurn Engineered Low Pressure Drop Strainers are patented and patents pending. Copyright 1953.

J. A. ZURN MFG. CO.

INDUSTRIAL DIVISION • ERIE, PA., U. S. A.

In Canada: Canadian Zurn Engineering Ltd., Montreal, 25, P. Q.

J. A. ZURN MFG. CO.
Industrial Division, Erie, Pa., U. S. A.

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Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on pages 37 and 135 for your request. Just circle the numbers of the items you'd like to know more about

1—VOLTAGE REGULATOR

Is re-designed unit offering compactness and simpler maintenance

Improvements in this company's Type SU Induction Voltage Regulator have resulted in a lighter and dimensionally smaller unit said to be simpler to maintain. Mechanical adjustments have been eliminated from the control; and the voltage regulating relay used in the new all electrical control is company's Type SJ, reported to operate 100 million times on test without recalibration.

All relays are now mounted on the back of a swinging panel to facilitate periodic inspection. A handwheel at the upper end of the vertical motor shaft allows hand operation, and a vertical terminal board has connections for series or parallel operation of the secondary winding. Westinghouse Electric Corp.

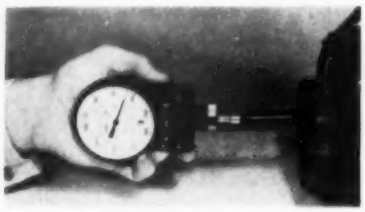
2—COMBINATION ANALYZER

Offers analyses of excess air and combustibles in a compact unit

Designed to provide vital operating information on combustion performance, this gas analyzer is said to help save fuel dollars — especially where multi-fuels of varying composition are fired — and to act as a safety guide to prevent the lighting off of unpurged, gas-fired combustion chambers.

Analyses of per cent O_2 (an index of excess air) and per cent combustible (an index of fuel-air mixing performance) are offered. The analyzer and its recorder are designed to indicate or automatically control the necessary adjustments required to maintain maximum combustion efficiency within combustion equipment limitations.

Minimum range of the analyzer is 0 to 5 per cent, and maximum range is 0 to 25 per cent. Product Specification E65-1 gives complete engineering details. Bailey Meter Co.



4—RPM CHECKER

Is portable unit for use on motors, machinery, revolving shafts

This instrument is designed for instantaneous checking of revolutions per minute — applications for it are found wherever motors or machinery are used. To use it, you press the rubber tip against the revolving shaft. Then you read the rpm directly off the dial. It checks speeds from 40 to 50,000 rpm. The instrument is housed in black finished metal, has leatherette case. The price is $75.00. Montgomery & Co., Inc.

5—PIPE THREADER

Is self-contained unit designed to fit all standard power drives

The 504 Pipe Threader for use on power drives is a recent addition to this manufacturer's line of pipe tools. This pipe threader is self-contained and can be adjusted to thread 1 to 2 in. pipe using only one set of dies. The handle retracts dies instantly without stopping power drive, it is stated, and dies can be adjusted without removing the threader from the machine. The threader fits standard power drives.

Other features of the 504 include a set of high-speed steel dies and a pre-set four-jaw centering guide. Company points out that it will cut oversize, undersize and extra long threads. The Ridge Tool Co.

3—DISPOSABLE PAPER WIPERS

For industrial wiping jobs; are clean, strong, and conveniently packaged

Each of these wipers consists of two "Perf-Embossed" sheets which, by a special process, are welded together for durability, good cleaning action, and maximum dirt retention. They are also chemically treated for greater wet strength. Manufacturer says they drink up oil and water — can be used wet or dry, or dipped in solvents.

Besides offering a solution to the problems of high unit and handling costs, erratic performance, and pilferage — common to many wiping methods — these disposable wipers offer safety and sanitary advantages. When a man takes a fresh one out of the handy "pop-up" box he's not risking cut hands from steel shavings left from a previous wiping job. And, as manufacturer points out, there's less possibility of dermatitis spreading through a plant when there's an ample supply of clean wipers.

There are 125 paper wipers to the box, which is so designed that as one wiper is removed, another is automatically pulled into position for easy removal. The boxes are compact, and come eight to carton. Scott Paper Co.

6—PORTABLE INSTRUMENTS

For indicating volts, watts, amperes, and milliamps; in two types

Two series of improved portable electric instruments are announced as offering maximum convenience and readability. The Type DP-11 is intended for general testing for electrical maintenance men who need a rugged, easily-read indicating instrument with an accuracy of ½ of 1 per cent of full scale. The Type DP-12 is described as a high precision testing instrument.

The new instruments are encased in molded Textolite. Company says that even under rough handling and operating conditions the spring mounted jewel bearings prevent damage to the indicating mechanisms. The mechanisms of both instruments are similar — each contains a moving coil and a concentric magnetic structure with a soft iron core. Two alnico magnets are die-cast inside a soft steel ring. The moving coil and iron core are mounted in a separate die-cast frame fitting between the magnets. General Electric Co.

7—TORQUE WRENCHES

Calibrated in inch-pounds; come in three models and two sizes

These six torque-limiting wrenches added to company's Proto line supplement the six foot-pound models introduced recently. Capacities of the new torquers are 100-750 and 700-1600 in.-lb. Three models have a plain head and

three have a built-in reversible ratchet head. Drive sizes are ⅜ and ½ in. Availability of both inch-pound and foot-pound models provides suitable torquers for repair, installation, assembly and inspection work.

The new torque-limiting wrenches are designed to release at the proper setting and reset themselves automatically. They have no projecting accessories, and all employ an enclosed precision spring as the principal torque-controlling element and have a micrometer-type adjustment. Ratchet head models do the work of both torque wrench and ratchet. Advantages claimed by manufacturer for these torque-limiting wrenches over torque-indicating types are greater speed, accuracy, versatility, safety and ease of use. Plomb Tool Co.

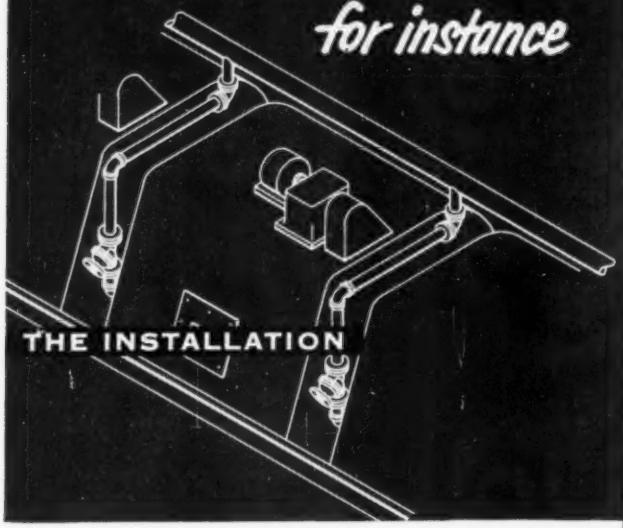
8—TUBE FITTINGS

Male elbows made of steel, in long and extra-long stock lengths

Standard stock items added to this company's Triple-lok line of industrial tube fittings, these new ones will serve the same applications — industrial hydraulic systems, instrumentation; process piping; machinery lubrication systems; diesel engine fuel systems.

Addition of the long and extra long male elbows offers greater flexibility in planning tube circuits. For example,

These Valves Last Longer-at Lower Cost ... on Toughest Water Services for instance



VALVE SERVICE RATINGS

SUITABILITY: Ideal for the job

FEATURES: Packless – No stuffing box

MAINTENANCE COST: None

SERVICE LIFE: Show no wear after more than 3 years

OPERATING RESULTS: No leakage – easy operation

AVAILABILITY: Regular Crane item – No. 1611

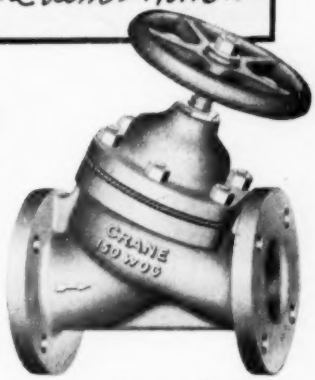
In a Southern public utility's power plant, with Crane Diaphragm Valves on water spray lines for cleaning traveling screens on condenser water intake.

THE CASE HISTORY

Both raw Mississippi River water and deep well water are used for the cleaning spray to the screens. The valves are exposed to a combination of river water sand erosion, and well water sodium chloride corrosion. These conditions caused stem packing leaks, difficult valve operation, and also corroded the steel bonnet bolts. Maintenance costs were excessive.

The trouble was stopped by installing Crane No. 1611 Packless Diaphragm Valves featuring separate disc and diaphragm design. After more than 3 years' operation, they show no effects of service. They operate smoothly and seat tightly. Crane Diaphragm design eliminates leaks entirely, and no maintenance has been needed. Based on this performance record, additional Crane Diaphragm Valves have been installed.

THE VALVE



In Crane Packless Diaphragm Valves, the diaphragm seals the working parts from all erosive or corrosive fluids. Need for a stuffing box is eliminated. Choose these valves from a wide variety of body and trim materials, lined or unlined, for better, lower-cost handling of countless corrosive, erosive, or ordinary services. See your Crane Catalog or your Crane Representative.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

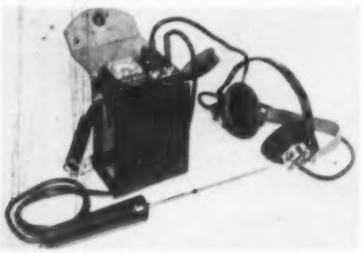
For more data circle 528 on Post Card

shorter standard shaped elbows may be "nested" within the longer elbows. Although the standard stock of these new fittings will be steel, the new shapes are available in certain other metals on special order. The fittings as purchased include body nut and sleeve. Bulletins 4310A10 and 4310A11 give further data. The Parker Appliance Co.

9—ELECTRONIC INSTRUMENT

Is audio-video model of a portable device for finding noise sources

As a practical help in maintenance, testing and inspection, this company has introduced the Model V, an audio-video version of the Elec-Detec, a portable electronic instrument for locating noise sources in all types of mechanical equipment. It includes a milliammeter for

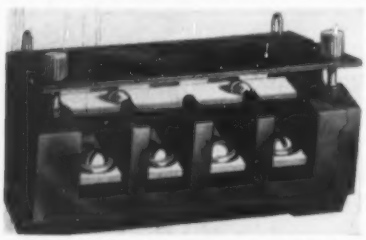


checking sound impulses visually, in addition to headphones for audible operation. This combination lets the operator "see," as well as hear, the location of the source of trouble in bearings, pistons, gears, ratches, cams, clutches and other parts. Anco Instrument Div., American Name Plate & Mfg. Co.

10—TERMINAL BLOCKS

Heavy duty, molded; are now available with hinged covers

The non-separable hinged covers, now available on these molded terminal blocks, offer added protection to control and circuit wiring and afford ready access to connections. The blocks can be



furnished with either screw or solderless type contacts, and in four-, six-, eight-, or 12-circuit sizes with either plain or numbered marking strips. They are rated at 750 v, 35 amp for the screw type, and 750 v, 50 amp for the solderless type. These blocks are also available without covers or with screw-on separable covers. A catalog gives details on these terminal blocks. Buchanan Electrical Products Corp.

11—RUST PREVENTIVE

Has particular application for turbine lubricating oil systems

Oilcoat T is a compounded oil with a non-metallic high potency additive to prevent corrosion of metal surfaces. Although designed particularly for use in steam and gas turbine lubricating oil systems to prevent corrosion of metal surfaces during the time interval between shipment of the turbine from the factory to erection in the plant in which it is to operate, the oil has other applications, too. It can be used to prevent rust in the oil systems of other types of machinery under similar service conditions and to protect metal surfaces against corrosion under high humidity conditions of storage.

In addition to its rust protection properties, a chief characteristic announced for this light viscosity oil is compatibility with turbine lubricating oil. Many oil soluble rust preventive compounds used to prevent rust in internal parts of turbine lubricating oil and governor systems during shipment have detracted from the functional characteristics and life of the turbine lubricating oils. This is of particular significance when the turbine operator flushes the lubricating oil system with the same oil to be used for lubricating the turbine in service.

Tests are also reported to show that Oilcoat T prevents rusting under conditions of use for which it was developed, and displaces any water film in the event that the metal surfaces to be protected are already wet. It can be applied by spraying, dipping or brush application. Gulf Oil Corp.

12—PIPE MARKERS

Are easily removed from new-type backing; just as easily applied

Applying even the largest sizes of this company's pipe markers and other markers is now claimed effortless — due to the use of a new release coating on their backing cards. It's not necessary to tug on the marker to pull it off the card. Manufacturer calls this coating the Blue Streak Chromatic Abhesive, coining the word "abhesive" (as the opposite of "adhesive") to describe a formula that decreases the tendency of materials to stick to each other. The abhesive coating is applied to the backing card over the same area as the marker. It is rendered inert, so as not to affect the pressure sensitive adhesive on the marker.

The new coated cards will be used on wire markers, pipe and conduit markers, safety signs, fluid line markers, write-on labels and special markers. Literature on these markers and a sample are offered. W. H. Brady Co.

13—CORONA TEST SETS

For non-destructive evaluation of electrical insulation

These corona test sets are announced as safe enough, simple enough and reliable enough for use by non-engineering personnel. The sets consist of a control unit, a detector unit, and a high voltage corona-free testing transformer which incorporates means of picking up corona signals from the equipment under test. In operation, equipment to be tested is connected to the high voltage terminal of the testing transformer and 60 cycle test voltage is increased until corona indication appears on the cathode ray

tube in the detector unit. The rms equivalent of peak voltage is then read from the peak voltmeter. Bulletin 66 gives data and prices. James G. Biddle Co.

14—WALL BOX DETECTOR

Squeals when it locates plastered-over wall boxes, conduit, piping

The Model 202 Wall Box and Conduit Detector is an electronic instrument designed for quick location of conduit,

outlet boxes, steel reinforcements and heating pipes in walls. Company says it can locate plastered over outlet boxes —even through chicken wire.

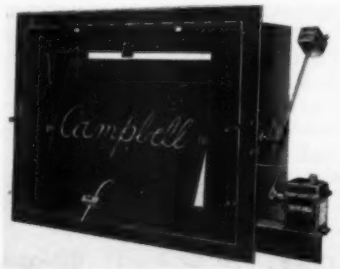
The detector is declared simple to operate. It is adjusted to a wall in a matter of minutes, manufacturer says, and then the operator can "cover" the wall area, holding the instrument about an inch away. When a conduit is crossed or a wall box approached, a loud squeal sounds in the speaker. The Model 202 is powered by standard, dry cell batteries and may be used by untrained personnel. It can also be used to detect lost tools and other metal objects covered over by soil. It is small and compact, weighs 3½ lb.; it is announced as moderately priced. An illustrated folder gives details. Detectron Co.

15—DRAFT CONTROL

Is electric unit suitable for both coal- and oil-fired heating plants

This is a new and improved model of the Campbell Electric Draft Control. According to manufacturer, its efficiency is due to the incorporation of two damper openings. A smaller damper operates barometrically when the stoker or burner is firing, in much the same manner as conventional draft control equipment. But, when the burner or stoker shuts off, a larger draft gate takes over.

This electrically-operated check damper moves to a full-open position,



by-passing about 80 per cent of the chimney pull, company explains; so that at the point of peak heat, the chimney is forced to make most of its pull from the boiler room air rather than from the boiler itself. Thus, thousands of Btu's otherwise wasted up the stack are retained in the combustion chamber, it is pointed out, and this results in longer "off" periods for the stoker or the burner. Fuel Reduction Corp.

FOR POWER
Bituminous of every type for efficient burning in the latest pulverized-fuel installations
FOR COKING
Bituminous coals of exceptional quality for by-product coking
FOR STEAM
Firm-structured Bituminous with high heat values for every steam-plant use
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Many varieties of non clinkering coals ideal for stoker use and hand firing
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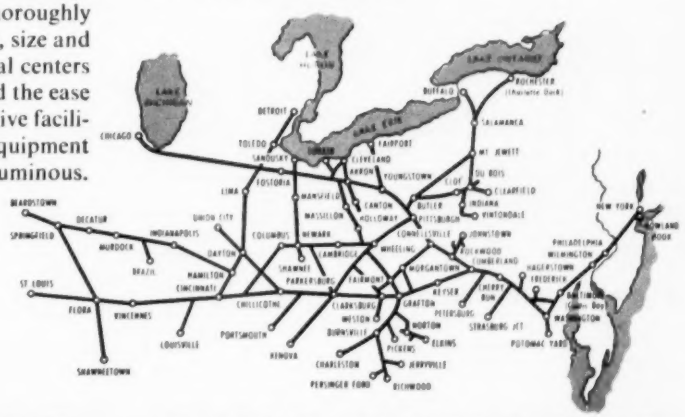
B&O Bituminous coals exist in wide variety. The mines that produce them are thoroughly mechanized so that costs are kept low, size and quality uniform. Nearness to industrial centers results in low transportation costs, and the ease of storing removes the need for expensive facilities. Furthermore, new methods and equipment have increased the burning value of Bituminous.

ASK OUR MAN! Let him direct you to the best coal for your needs, and explain proper firing methods. You'll be more than pleased at the improved efficiency, economy, and cleanliness of B&O Bituminous.



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Constantly *doing things*—better!

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16—CONDENSER TESTER

And leakage indicator, has built-in electronic power supply

The Model CT-1 is a new electronic condenser tester and leakage indicator; it features a built-in electronic power supply providing both a-c and d-c test voltages and contains miniature selenium rectifier and dual capacitor RC filter network in a special circuit with a sensitive neon lamp leakage indicator.

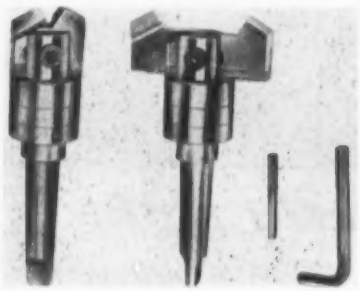
It is designed to permit quick, accurate direct testing of condensers for leakage with actual d-c voltage applied and to indicate intermittent open condensers with a-c applied. It is also suggested for high resistance continuity testing of electrical and electronic circuits and parts, indicating leakage, resistance or insulation breakdown to over 200 megohms. It comes complete with 6 ft power cord and rubber plug, test lead and instructions. It operates on any 110-125 a-c power line. Lee Electronic Labs., Inc.

17—ADJUSTABLE DRILL

Utilizes only two sets of blades for cutting any size hole from 2 to 4 in.

This new drill is designed to cut any size hole from 2 to 3 in. with one set of blades, and any size hole from 3 to 4 in. with a second set of blades. It is also said to cut oversize for clearance or undersize for press fits. According to manufacturer, the solid drills this tool can replace would cost more than $9500 if bought separately.

The illustration shows one drill in extreme extended position, and another,



with smaller blades, in extreme contracted position. A scroll ring engaging the bottom sides of the blades performs the double function of adjusting the blades and supporting them against the thrust of the cut. The body of the drill is alloy steel and the blades are high speed steel. The drill costs around $160 with two sets of blades. It is available with carbide-tipped blades at nominal extra cost.

The drill finds its greatest value when used on drill presses and radials, but it is also suggested for use on horizontal boring mills, turret lathes, tool room and engine lathes, and wherever an occasional hole must be drilled and a complete set of solid drills would represent an unwarranted investment. Hayden Twist Drill Co.

18—POWER-LINE CARRIER

For power system relaying, telemetering and supervisory control

One of the features announced for this new equipment is closer channel spacing made possible by highly selective receiver filters and crystal control of frequency. Frequency ranges are 40 to 90 and 90 to 200 kc. Assemblies operate from either station battery or alternating current. Westinghouse Electric Corp.

You may use the post cards on pages 37 and 135 to ask for further information on any of these new products

19—OSCILLOGRAPH

Is seven-element automatic unit for recording system disturbances

The Type PM-13 is for recording power system disturbances and photographically recording pre-selected magnitudes, wave shapes, and phase relations. It has seven permanent magnetic, fluid-damped galvanometers with a separate shunt and resistor unit for adapting them to current or voltage measurements. Relays and controls are provided for starting the instrument automatically by overcurrent in ¼ cycle, and stopping it after a predetermined interval or after the fault has cleared.

Oscillograms automatically recorded at the time of a transient disturbance will provide the relay or system engineer with circuit breaker performance, relay performance, system performance and fault location. With such data provided, the engineer can visualize the behavior of the system and its apparatus under fault conditions. The instrument features continuous monitoring and its unit subassembly construction permits simplified inspection and maintenance. Detailed information on the new oscillograph is provided in Bulletin GEC-396. General Electric Co.

20—SLUDGE CONTROLLER

Designed to control the flow of sludge or heavily laden liquids

This 8-in. dia squeeze controller is said to overcome most of the difficulties of regulating heavy viscous flows, even if corrosive, without affecting the moving parts of the controlling mechanism. Its flexible rubber section has no pockets or restrictions which could trap particles of putrescent material, since the unit is self-scouring, it is noted. Company says it can produce a condition of complete cut-off, if necessary, or wide-open flow.

Core of the device is a venturi tube with a throat section of flexible rubber. Differential pressure in the venturi is transmitted to a rate setter which measures and maintains the flow. If the flow tends to change, this meter actuates a motor-driven clamping device in the controller in order to adjust the throat area. Simplex Valve & Meter Co.

21—MOTOR GENERATOR SETS

Designed to provide continuity of power supply to microwave systems

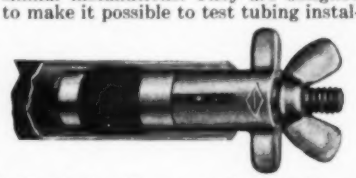
These flywheel motor generator sets and associated emergency transfer control are said to assure continuity of power for microwave equipment used for protective relaying, supervisory control and communication. During normal operating conditions, the set operates on the commercial power system. When there is a power system disturbance, or outage, the energy stored in the flywheel drives the generator to supply power, with a frequency tolerance down to 50 cycle for a 7 sec interval. This interval, manufacturer points out, allows enough time for the automatic starting of an emergency standby generator set and the automatic switching of microwave equipment from flywheel motor-generator set to emergency power source.

Automatic transfer control has a frequency relay sensitive to a 1½ to 2 cycle decline which acts to initiate starting of the standby power supply. When standby power voltage and frequency are normal, a mechanically interlocked throwover switch connects the microwave equipment to the standby set. The microwave equipment is automatically transferred back to the motor-generator set when commercial power is restored. Publication 200-FF-22 gives data. Electric Machinery Mfg. Co.

22—TUBING TEST PLUG

For use where it is desirable to shut off a tube temporarily

These plugs are said to be especially convenient for use in instrumentation, radiant heat, refrigeration, LP gas and similar installations. They are designed to make it possible to test tubing instal-



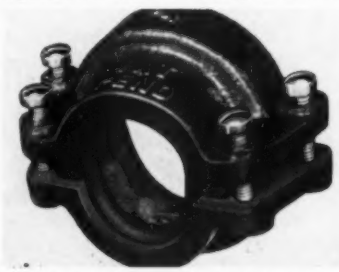
lations before they are put in service, or when locating leaks.

The plug is inserted in the end of the tube and the wing nut tightened. This expands the synthetic rubber portion of the plug and seals the tube. The plugs are said to hold pressures to 100 lb, and are suggested for use on all liquid or gas tubing lines except those conveying material that would deteriorate synthetic rubber. The plugs are available in five sizes form ¼ to ¾ in. OD. Bulletin 111-REF describes the plugs. The Imperial Brass Mfg. Co.

23—HEAVY DUTY CLAMP

Provides long-lasting seal for water, steam, oil or gasoline lines

The Bel Connector is announced as a cast-iron fitting that seals pipe leaks quickly, safely and without cutting off the flow. The connector is made in two parts joined by four screws, and is designed to enclose the leak within captive Neoprene gaskets when the screws are tightened around the clamp. The sealing



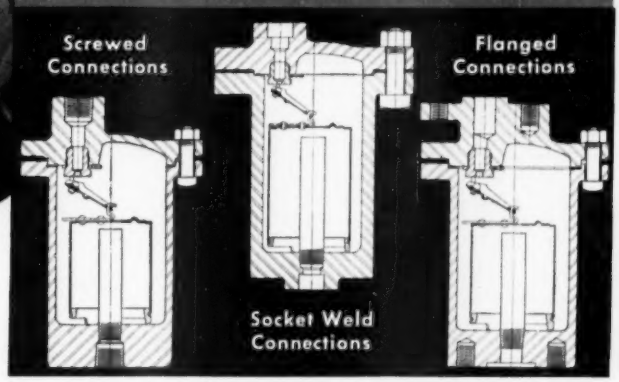
gaskets thus form a gas-tight chamber which equalizes pressures inside the pipe and out, manufacturer explains; the fitting itself exerting no pressure on the leak or the weakened area around it. Since contact of the device with pipe and fittings is on Neoprene, the resulting joint will withstand vibration, it is pointed out — it acts as an expansion joint in steam and hot water systems.

Besides sealing leaks in existing systems, these connectors may be used to assemble temporary lines. Elbow and straight types can be furnished, and in a variety of sizes. Holoal Mfg. Corp.

No. 515 Armstrong trap operating at 875 psig, 910F at West Texas Utilities Co. Lake Pauline Plant

FOR HIGH PRESSURE CONDENSATE DRAINAGE...

(UP TO 2400 LBS.)*



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ARMSTRONG FORGED STEEL STEAM TRAPS!

Because:

1. *They provide dependable automatic drainage* of condensate and boiler carryover for protection of valves, turbines and other equipment.

2. *They have been thoroughly proved* in use in important power plants all over the world.

3. *Armstrong has built thousands of them* since 1929 and has the experience necessary to insure safe design and application. In fact, Armstrong pioneered the development and application of traps for high pressures and has continuously kept pace with the trend to higher pressure plants.

4. *Generous margins of safety are provided,* not only in the forged bodies and caps, but in the power provided for opening the valve and in bucket buoyancy for closing the valve. There is no steam waste and no failure to open.

5. *The quality is unsurpassed*—chrome steel valve and seat are hardened, ground and lapped; other working parts are stainless; bodies, caps and bolts and nuts are of materials approved for pressures involved.

6. *The cost is moderate*—first cost because of quantity production, long run cost because of low maintenance.

7. *They are guaranteed to give complete satisfaction.* Your local Armstrong Representative is fully qualified to discuss your forged steel trap applications and to answer your questions. Give him a call, or write:

ARMSTRONG MACHINE WORKS
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* Many plants, particularly refineries and chemical processing plants use Armstrong forged steel traps at 250 lbs., or less, pressure to secure the advantages of all-steel fittings and freedom from damage in event of fire or explosion.

FOR COMPLETE INFORMATION

Send for the new 44-page Steam Trap Book — includes physical data and list prices, service pressure rating tables, list of materials and other data pertinent to forged steel traps *plus* information on cast traps and trap selection, installation and maintenance for all condensate drainage jobs. Free on request — no obligation.

ARMSTRONG STEAM TRAPS

For more data circle 530 on Post Card

POWER PLANT *Construction News*

Anaheim, Calif. — Galvatex Coatings Corp., 93 N. Arroyo Prkwy., Pasadena, Calif., paints, lacquers and enamels, plans boiler house at new plant at Anaheim, where 30-acre tract of land has been acquired. Work will begin soon. Cost not announced. Fluor Corp., Ltd., 2500 Atlantic Ave., Los Angeles, Calif., is architect-engineer. Main offices of company are at 902 72nd Ave., Oakland, Calif.

Eureka, Calif. — Pacific Gas & Electric Co., 245 Market St., San Francisco, Calif., will build a new steam-electric generating plant at Eureka, estimated to cost about $9,900,000, with turbine generators, high-pressure boilers, and auxiliary equipment. It was previously reported that company would expand present power plant at that place. Project has been approved by Government.

Los Nietos, Calif. — Bell Brand Foods, Ltd., 4611 Pacific Blvd., Vernon, Los Angeles, Calif., prepared food products, plans boiler house at new food processing and production plant on Los Nietos Rd., Los Nietos, near Los Angeles. Entire project reported to cost close to $250,000. Work scheduled to begin soon.

Whittier, Calif. — Catalina Knitting Mills, 443 San Pedro St., Los Angeles, Calif., knitted outerwear, bathing suits, etc., plans boiler house at new knitting mill at Whittier, where site has been acquired. Work will begin soon. Cost about $130,000.

Grand Junction, Colo. — School District No. 54, Mesa County, Grand Junction, plans boiler house for central-heating service at new one- and two-story high school. Entire project estimated to cost about $2,000,000. Atchison & Kloverstrom, 1254 Monaco Prkwy., Denver, Colo., are consulting engineers.

Tampa, Fla. — Tampa Electric Co., Tampa, has acquired a tract of land at Black Point, Hillsborough Bay, for a consideration in excess of $100,000 and is reported planning new steam-electric generating plant at that location.

Winter Garden, Fla. — Continental Can Co., Inc., 100 E. 42nd St., New York, N. Y., plans boiler house at proposed new plant unit at Winter Garden, to be used for manufacture of tin cans and containers. Entire project reported to cost about $500,000. Work will begin soon.

Savannah, Ga. — American Cyanamid Co., Calco Chemical Div., 30 Rockefeller Plaza, New York, N. Y., plans steam power house at new plant at Savannah, for production of titanium dioxide. Company has selected tract of 1600 acres of land, with frontage on Savannah River. Plant will comprise several buildings and is reported to cost over $13,000,000. Robert & Co., Associates, Inc., 96 Poplar St., N. W., Atlanta, Ga., is architect and engineer.

Joppa, Ill. — Electric Energy, Inc., lately organized by a group of public utility companies, is arranging financing in amount of $30,000,000, proceeds to be used for construction of a steam-electric generating station, power substations, transmission lines and other facilities, output to be used primarily by Atomic Energy Commission at its plant at Paducah, Ky., on opposite side of Ohio River from Joppa.

Kansas City, Kan. — Reichhold Chemicals, Inc., 601 Woodward Heights, Ferndale, Detroit, Mich., plans boiler house at proposed new plant on eight-acre tract of land in Fairfax industrial district, Kansas City, recently acquired. Factory will be equipped for production of synthetic resins. Cost reported close to $1,000,000.

Lake Charles, La. — Continental Oil Co., Sterling Bldg., Houston, Tex., is reported planning boiler house at proposed new natural gasoline plant, near Lake Charles. Also, compressor units and auxiliary equipment for large capacity. Entire project is estimated to cost about $1,500,000. Work will proceed at early date.

Worcester, Mass. — State Department of Mental Health, 15 Ashburton Pl., Boston, Mass., plans boiler house at State Hospital at Worcester, to cost approximately $500,000, with tunnels, pipelines and other auxiliary facilities. M. A. Dyer Co., 24 School St., is architect and Hayden, Harding & Buchanan, Park Square Bldg., mechanical engineers, both of Boston.

Gladstone, Mich. — City Lighting Dept. will have plans prepared by Pfeifer & Schulz, Wesley Temple Bldg., St. Paul, Minn., consulting engineers, for new municipal electric light and power plant recently noted in these columns. A bond issue of $2,200,000 has been approved for project.

Grand Rapids, Mich. — Board of Directors, Michigan Veterans' Facility, Grand Rapids, is having plans prepared for new power house at institution, for central-heating and other service. Cost reported about $1,000,000. St. Clair Pardee, St. Johns, Mich., is architect.

Livonia, Mich. — American Vitrified Products Co., National Bank Bldg., Cleveland, Ohio, plans boiler house at new concrete pipe plant at Livonia, where tract of 18 acres of land has been acquired. Project will comprise several production units and is reported to cost about $500,000. E. L. Miller is vice-president and general manager.

Watson, Minn. — Montevideo Cooperative Canning Assn., Montevideo, Minn., plans boiler house at new food processing and canning plant at Watson, near Montevideo. Entire project will cost about $170,000. Work is scheduled to proceed soon. Gilbert H. MacMillan, 914 Marquette St., Minneapolis, Minn., is engineer.

Okolona, Miss. — Board of Supervisors of Chickasaw County, Okolona, plans boiler house at new one-story industrial building, to be constructed and owned by county, and occupied by Stratford Furniture Corp., 2509 West Cermak Rd., Chicago, Ill., under long-term lease, as a new branch factory. It will total about 79,000 sq. ft. floor space. Work will be placed under way at early date. Cost reported close to $400,000. John L. Turner, Medical Bldg., Jackson, Miss., is architect.

Independence, Mo. — City Council is considering a bond issue of $3,000,000, proceeds to be used in part for expansion and improvements in municipal power plant. A special election has been called to approve bond issue.

Mexico, Mo. — Lange Brothers, Inc., 1 Angelica St., St. Louis, Mo., commercial fertilizers, plans boiler plant at proposed new works at Mexico, where site is being secured. Factory will be developed for large output. Entire program is reported to cost in excess of $3,000,000.

Kalispell, Mont. — Anaconda Aluminum Co., 25 Broadway, New York, N. Y., an interest of Anaconda Copper Mining Co., same address, plans power house at new aluminum refining plant at Kalispell, comprising several large production units. Entire project will represent an expenditure reported close to $50,000,000.

Ithaca, N. Y. — New York State Gas & Electric Co., Binghamton, N. Y., will begin work soon on proposed new steam-electric generating station at Heddens, near Ithaca, on site of about 100 acres fronting on Cayuga Lake. Award has been made for structural steel for superstructure. Plant will have an initial rating of about 135,000-kw.

Canton, Ohio — Ohio Power Co., Canton, has arranged financing through sale of stock in amount of $7,000,000, proceeds to be used for expansion and improvements in generating facilities, transmission lines, power substations and other structures.

Ponca City, Okla. — Continental Blacks, Inc., care of Shamrock Oil & Gas Corp., 1400 West 10th St., Amarillo, Tex., recently organized by officials of last noted company and Continental Oil Co., 30 Rockefeller Plaza, New York, N. Y., plans power house at new carbon black plant at Ponca City. Project will include several production units, to provide output of about 40 million lb per annum. Program estimated to cost about $2,700,000.

Wynne Wood, Okla. — Kerr-McGee Oil Industries, Inc., Kerr-McGee Bldg., Oklahoma City, Okla., plans boiler plant at proposed new oil refinery at Wynne Wood. Entire project is reported to cost about $4,000,000. Program has been approved by Office of Defense Mobilization, Washington, D. C.

Altoona, Pa. — Pennsylvania Railroad Co., Pennsylvania Railroad Terminal, Philadelphia, Pa., has plans for new boiler house, in connection with expansion and improvements in shops at Altoona. Award has been made for structural steel framing and work will proceed in near future.

Philadelphia, Pa. — Jordon Refrigerator Co., 58th St. and Grays Ave., refrigerators, home freezers, etc., plans boiler house at new plant in northeastern district of city. Work will begin soon. Manufacturing unit will total more than 150,000 sq ft floor space. Entire program will represent a reported investment of close to $1,000,000. Company has sold present plant and will remove to new location when construction is completed.

Baytown, Tex. — Houston Lighting & Power Co., Fannin and Walker Sts., Houston, Tex., will construct proposed new steam-electric generating station near Baytown, on Houston ship channel, instead of Pasadena, as recently noted in these columns. A site of 700 acres of land has been selected. Installation will include a 165,000-kw turbine generator unit, high-pressure boilers and auxiliary equipment. Work is scheduled to begin in 1954, with completion early in 1956. Entire project is reported to cost in excess of $16,000,000.

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CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

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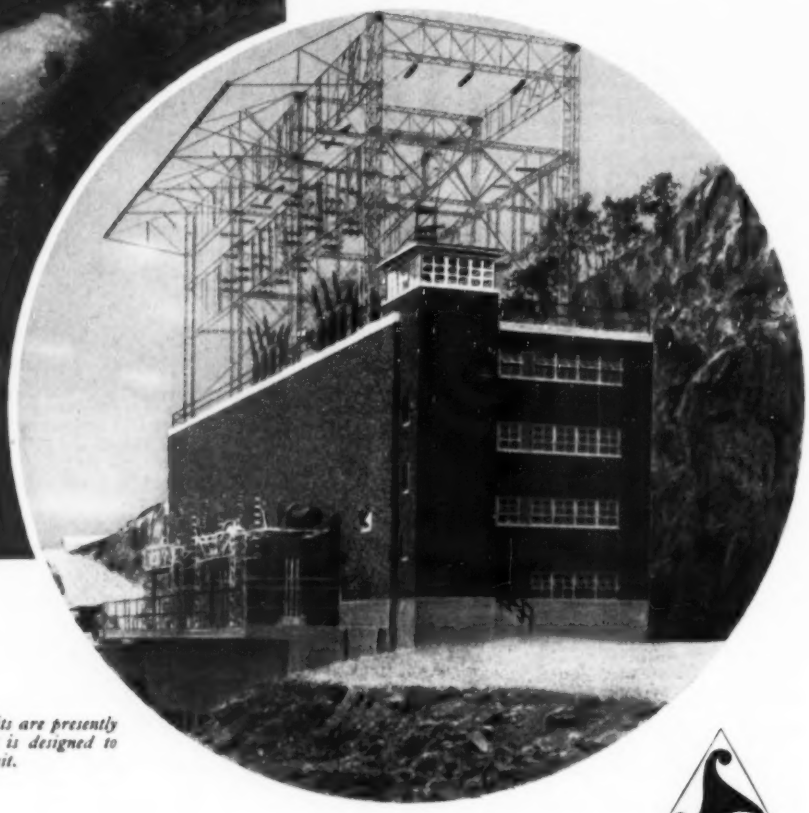
POWER FOR PAPER PRODUCTION

When Great Northern Paper Company needed more power for its operations in northern Maine, Stone & Webster Engineering Corporation was called on for consultation and recommendations.

The Corporation prepared a report, and subsequently designed and built the Ripogenus hydroelectric project on the upper Penobscot River. Water from a storage dam is brought downstream through a solid rock tunnel for 4000 feet to McKay Station.

The transmission line connection to the Millinocket plant and the required road work and bridges were engineered and constructed by Great Northern's own forces.



Two 13,500 kw units are presently installed. The plant is designed to house a third such unit.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

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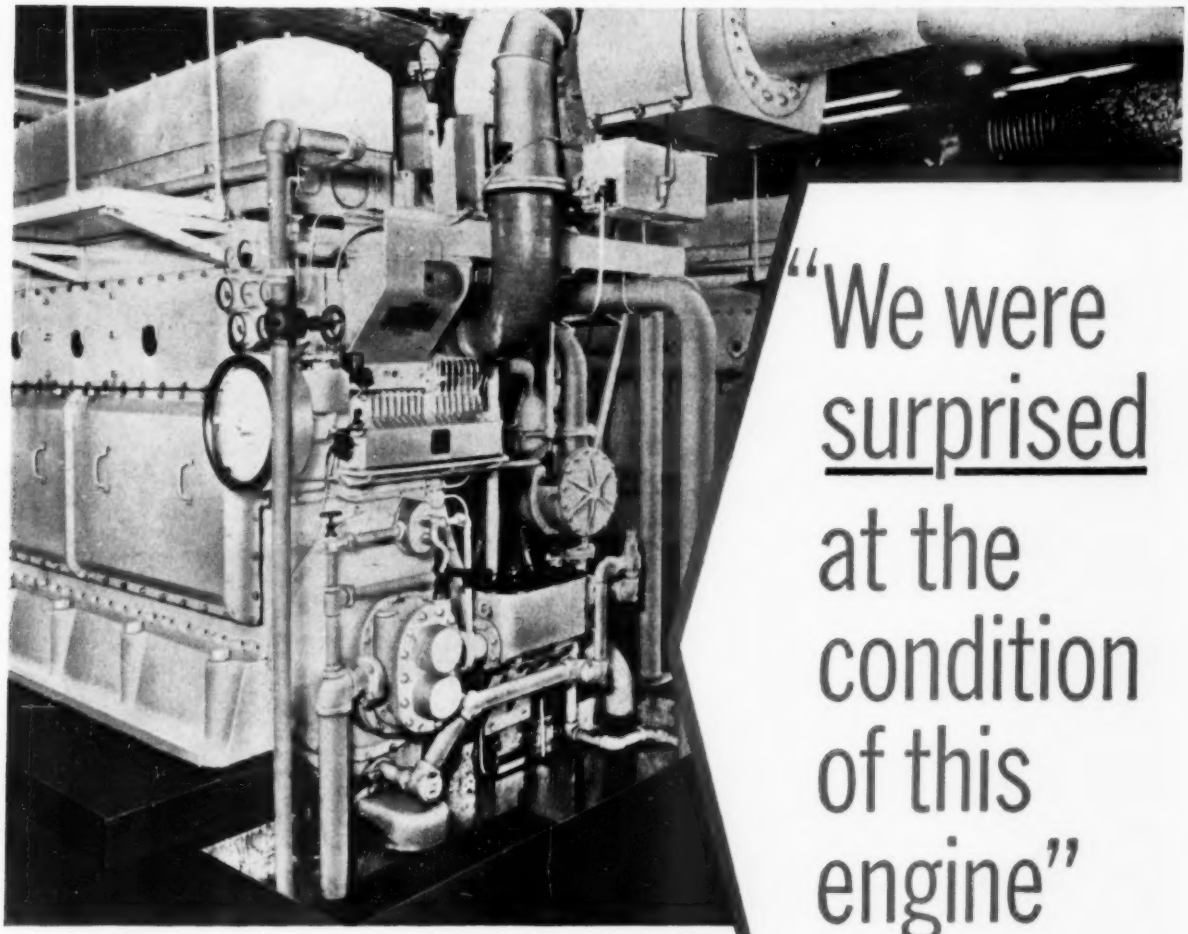

"We were surprised at the condition of this engine"

... says G. V. Yarger,
Supt. Municipal Utilities
Waverly, Iowa

"When we finally opened up our Worthington, it was in the *best* condition I've ever seen a diesel engine that had operated such long hours and under such heavy loads as this unit. It had a total of 48,926 hours on it – 8,987 hours of tough operation since the last overhaul.

Mr. Yarger continues, "We've been using Sinclair RUBILENE® Heavy in the crankcase and RUBILENE H.D. 30 in the cylinder lubricator. These RUBILENES have kept the crankcase and upper portions of the cylinders exceptionally clean and bright, with no sign of carbon or deposits."

That's a typical report on the exceptional qualities of the Sinclair RUBILENES . . . evidence that they could improve the efficiency of *your* diesels, too. Why not switch now? Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

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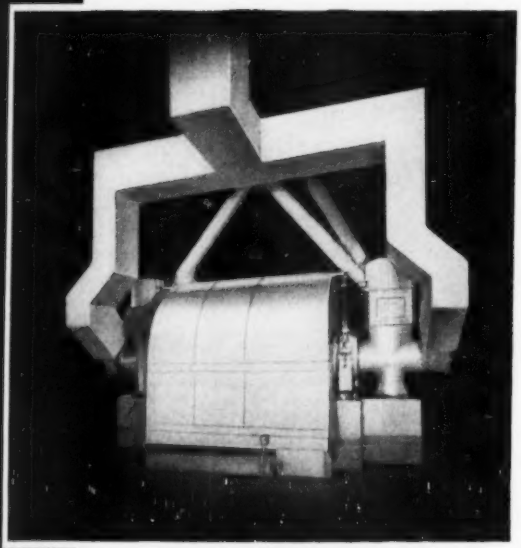
One source

... meets

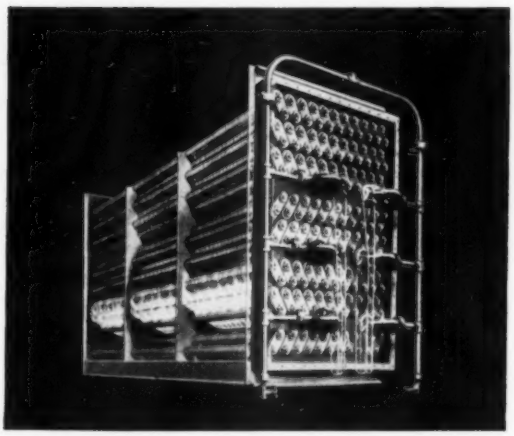
STEAM GENERATORS for every central station or industrial use, designed, engineered and built to meet your needs for the economies of higher temperatures and pressures over control ranges not previously obtainable.

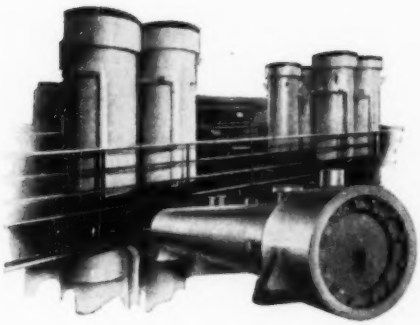


BALL MILL PULVERIZERS which grind hard, abrasive fuels to a constant fineness. Operating records show low maintenance, high availability of 99% or better.

SUPERHEATERS of the convection and radiant type, either singly or in combination. Superheat control over a wide load range is also offered as a means of positive and accurate control of final temperature.

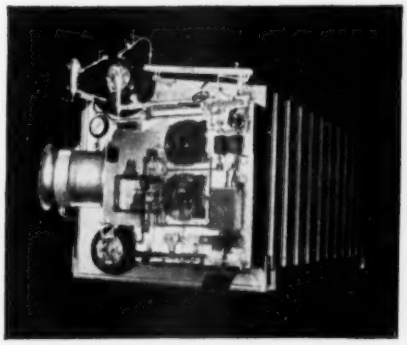
ECONOMIZERS of the cast-iron, extended-surface steel-tube type which are corrosion-resistant, impervious to soot fires, easily cleaned, and of unique, simple design. Bare tube construction also available.





PACKAGE STEAM GENERATORS in capacities of 10,000 to 30,000 lb. of steam per hr. Water-tube type, plant assembled, shipped ready to install. Design pressures of 250, 525, 825 psig provide operating pressures from 100 to 800 psig.

FEEDWATER HEATERS of the shell-and-tube type, as well as direct contact arrangements, are available. "Lockhead" closures have been built for pressures up to 3500 psi.

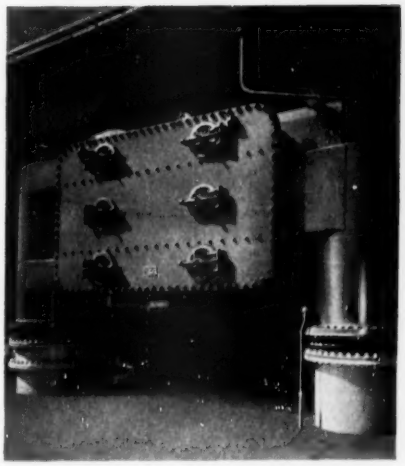


many of your steam plant needs

Only Foster Wheeler offers such a broad line of steam plant equipment engineered for increased efficiency through modernization.

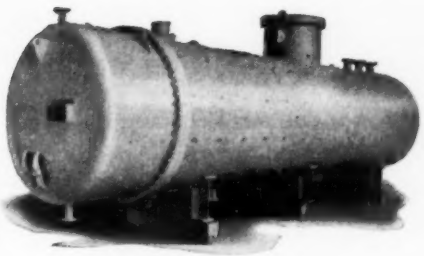
IN OVER 50 YEARS of service to the power industry, Foster Wheeler has pioneered the development of steam generators, fuel systems, condensers and cooling systems of the highest efficiency. Continuous research and engineering have created a background of technical experience, *as well as* an integrated line of equipment in which each individual product is designed to contribute to the efficiency of all.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.



CONDENSERS to meet any conditions of headroom at any location. Our shops are fully equipped to supply units of 100,000 sq. ft. and larger.

EVAPORATORS for boiler feed make-up and of heat-transformer types in all sizes. Special types to handle raw and treated make-up to give the best thermal and descaling operation as well as producing pure vapor.



COOLING TOWERS custom-engineered to meet your requirements for greatest economy. Mechanical draft, counter-flow type. Provide minimum spray loss, flexibility to meet all weather conditions.

FOSTER WHEELER

For more data circle 534 on Post Card

Know the pitch!

Specify **SCOVILL** PHOSPHORIZED

ADMIRALTY HEAT EXCHANGER TUBES

With Scovill men and methods on your team, you will get plenty of practical, helpful "signals" to long-life heat exchanger tube performance.

Scovill Phosphorized Admiralty Tube (Alloy 363), for example, is *made* differently... hot extruded from CONTINUOUS-CAST billets. As a result, it is *always* uniform in composition and temper; inhibitor content (phosphorus) is *always* at optimum percentage. Such tube shows superior resistance to corrosion and dezincification, especially where contaminated fresh, salt, or brackish waters are used in the circulation system.

Equally important, Scovill provides what many consider to be the most competent and comprehensive Heat Exchanger Tube Technical Service in the field. We make it our business to see that you get the right tube for your application and conditions... selected from the wide range of heat exchanger tube alloys we produce.

Inquiry and an outline of your needs are encouraged. Write on your business letterhead for our 40-page heat exchanger tube booklet. Scovill Manufacturing Company, 99 Mill Street, Waterbury 20, Conn.

SCOVILL
HEAT EXCHANGER TUBE ALLOYS

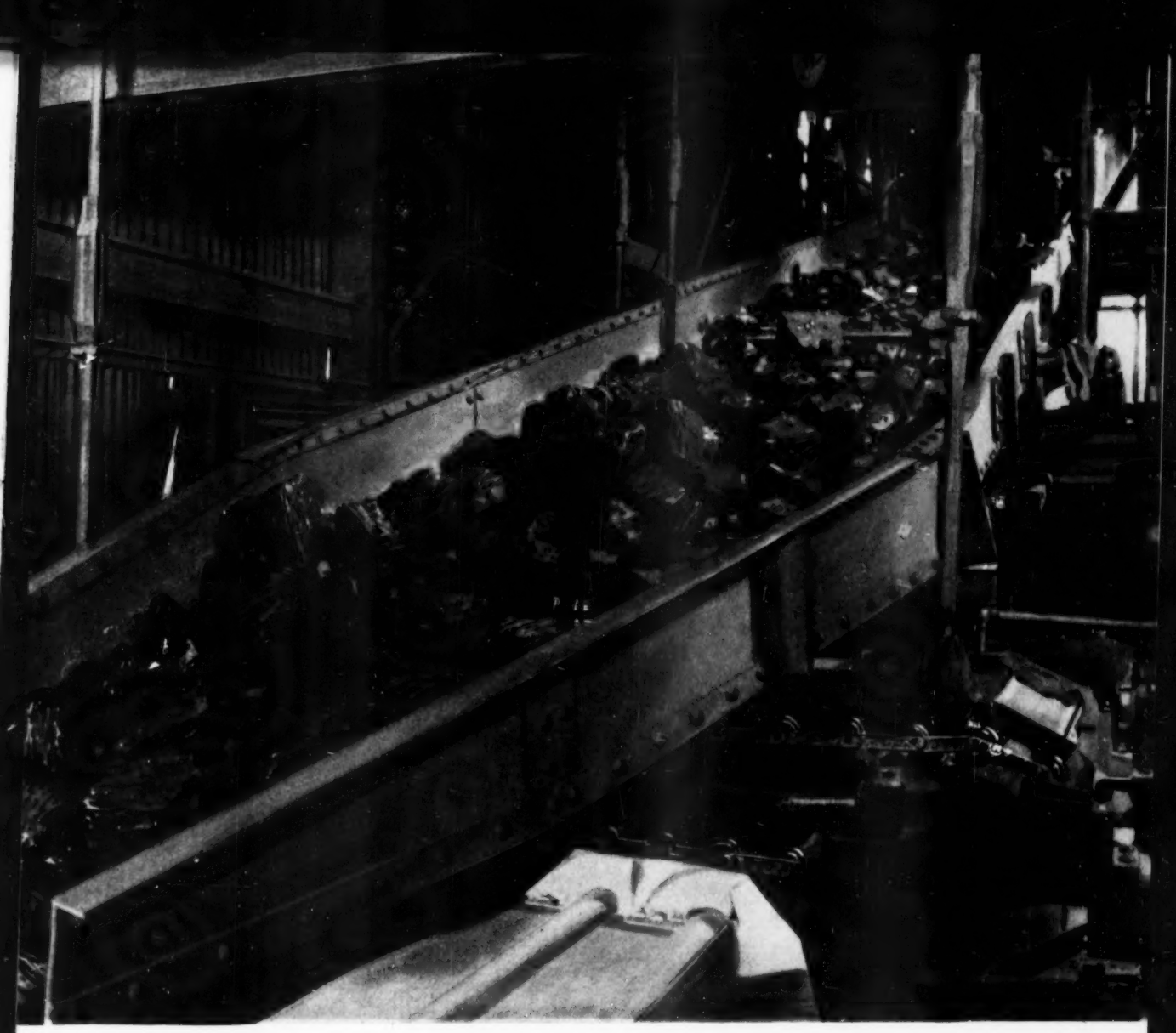
- PHOSPHORIZED ADMIRALTY
- ADMIRALTY
- ARSENICAL ADMIRALTY
- MUNTZ METAL
- NAVAL BRASS
- RED BRASS, 85%
- DEOXIDIZED COPPER
- ARSENICAL COPPER
- COPPER NICKEL, 10% & 20%
- CUPRO-NICKEL, 30%
- CUPRO-NICKEL, 30% (High Iron)
- ALUMINUM BRASS
- ALUMINUM BRONZE, 5%
- DUPLEX TUBE

SCOVILL

"You can't buy better Brass"

25C53

For more data circle 535 on Post Card



BEACON'S WIDE RANGE OF SIZES IS PREPARED ON MODERN SCREENING EQUIPMENT

BEACON COAL

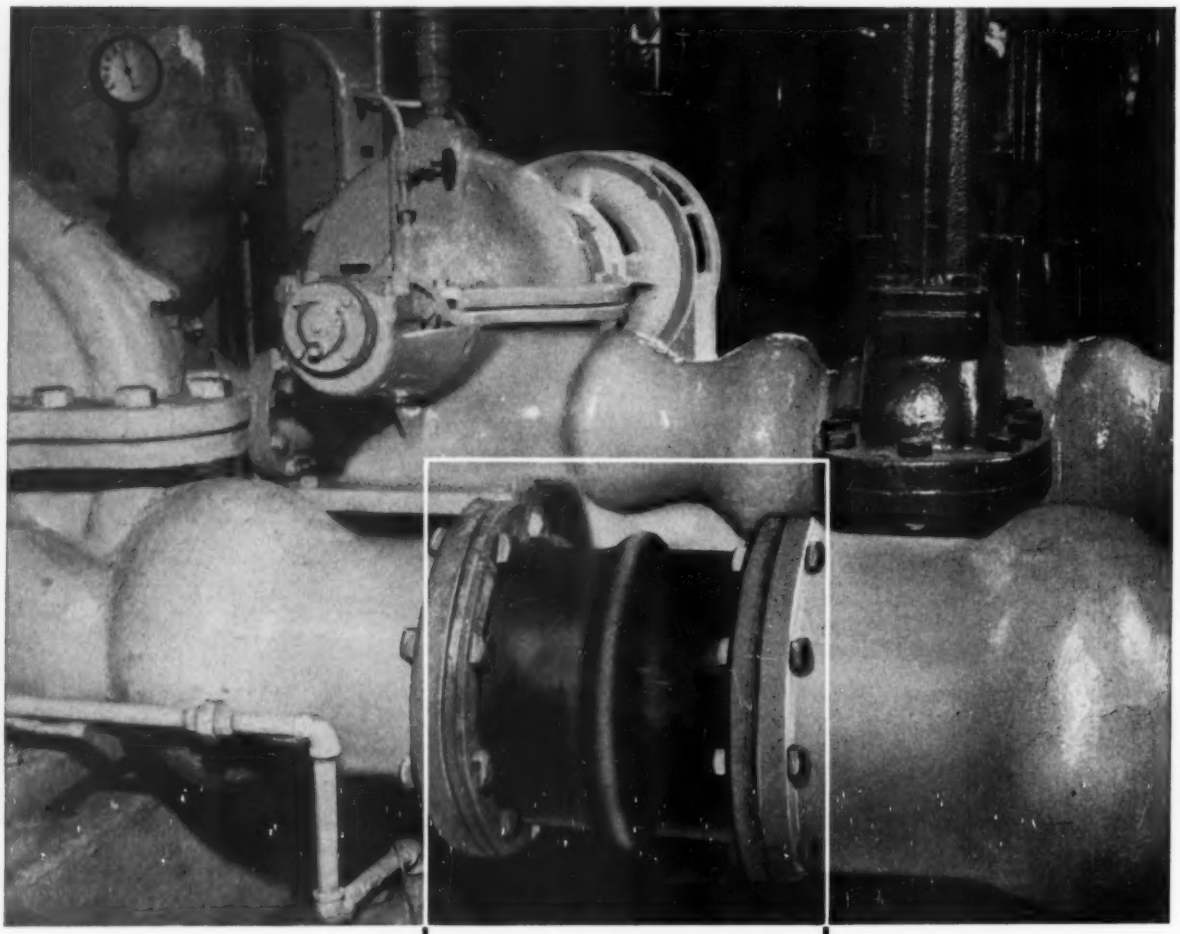
EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH • BOSTON • CHICAGO • CLEVELAND • DETROIT • NEW YORK
NORFOLK • PHILADELPHIA • SYRACUSE

For New England: New England Coal & Coke Co., For Export: Castner, Curran & Bullitt Inc.

For more data circle 536 on Post Card

Teammates for 24 years—
U. S. Expansion Joints and a power plant!



Close-up of U. S. Expansion Joint installed on vacuum line, still working after 24 years.

When a large Midwestern power plant was opened in 1929, the vacuum lines were equipped with rubber expansion joints by United States Rubber Company, the original manufacturer of rubber expansion joints. And with the passing of time, the power plant installed additional U. S. Joints on house service pumps, condenser pumps and main circulating pumps.

U. S. Expansion Joints always give trouble-free operation because they have no moving parts to wear or bind. These economical, flexible connections are used in pressure or vacuum pipe lines in mechanical equipment to prevent excess stresses due to expansion or contraction. They also insulate against vibration, prevent the transmission of noise, and take care of misalignment.

"U. S." engineers at any one of 25 District Sales Offices will gladly help you on problems of this kind, or write to address below.

U.S.RUBBER
SERVING THROUGH SCIENCE

"U.S." Research perfects it
"U.S." Production builds it
U.S. Industry depends on it

UNITED STATES RUBBER COMPANY
MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

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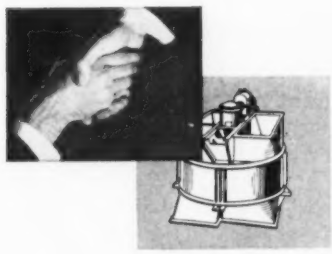
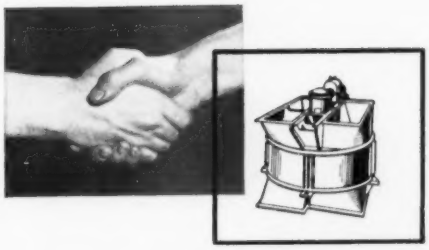




Why your Ljungstroms are so efficient

—year after year

Air Preheater Corporation Field Engineers aim to visit every Ljungstrom Air Preheater in this country at least once a year. Their main objective is to increase availability and assure you a maximum return on your investment. They are always available for consultation.

This is just another reason why the Ljungstrom Air Preheater is *the most economical heating surface on the modern boiler.*

THE AIR PREHEATER CORPORATION

60 East 42nd Street
New York 17, N. Y.

For more data circle 538 on Post Card

How ONE can equal SIX

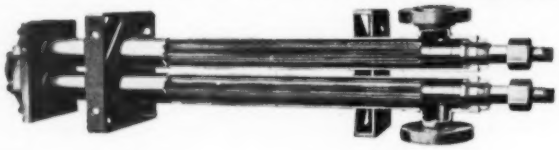
IN FUEL OIL HEATING

Conventional fuel oil heaters have bare tubes, with practically the same amount of surface inside and outside. But fuel oil requires more heat transfer surface than does the heating steam, because of its considerably lower heat transfer rate. Therefore, the number of bare tubes required for the heat-absorbing capacity of the oil is very much greater than the number which would be sufficient for the heat conductivity of the steam.

The G-Fin heat transfer elements of the G-R Twin G-Fin Section compensate for this difference in heat transfer rates of oil and steam. Their longitudinal fins have a total of more than 6 times as much surface as the interior of the elements. This means that a Twin G-Fin Section will have only 1/6 the number of tubes that would be required by a conventional bare tube heater for the same duty.

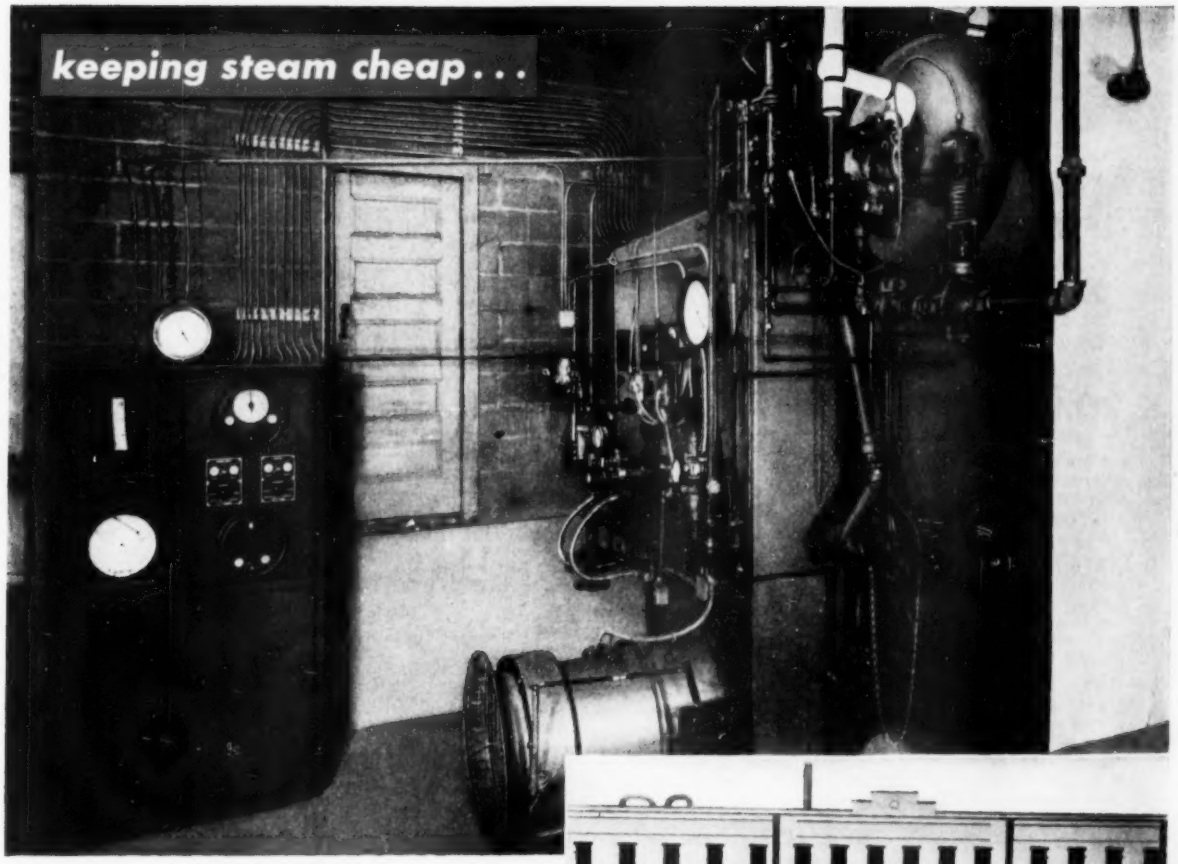
Investigate these compact, simple units and their many other advantages for heating your fuel oil. Complete information will be sent without obligation.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO



G-R HEAT TRANSFER APPARATUS *Twin G-Fin Section*

For more data circle 539 on Post Card



B&W's FIRST *Integral-Furnace Boiler, Type* FM

SAVING 20% ON FUEL ALONE

at New Method Service

After three years of operation at the modern plant of New Method Service—a leading Staten Island laundry and dry cleaning company—the first B&W shop-assembled, Integral-Furnace Boiler, Type FM, to go into service, has proved its economy and efficiency to the complete satisfaction of the company's management and operating personnel.

This self-contained B&W oil-fired unit was installed in May, 1950, as part of a modernization program for the big New Method plant, which has been serving Staten Island residents for 31 years. With a steam capacity of 20,000 lb per hr at a pressure of 135 psi, the FM Boiler supplies steam for both heat and processing requirements of the more than 5000 garments for dry cleaning and 4000 laundry bundles handled during the average week. The B&W unit, with automatic control, supplies steam at a constant pressure, raising considerably the overall plant operating efficiency. Cleanliness—essential in a laundry—is no longer a problem, due to the elimination of smoke and ash handling. Space-saving, in and around the plant, is another plus-factor. Outside areas formerly occupied by coal and ash piles have been put to more practical use, and boiler-room space made available by the new unit provides a maintenance shop for the entire plant. Boiler-room men report only minor maintenance since the B&W unit was put into service. Summing it up, Mr. Louis Lawch, President of New Method recently remarked, "We're very happy with our investment, the boiler runs like a charm."

Since the debut of B&W's Integral-Furnace Boiler, Type FM, at New Method, additional units of this type, placed in service or on order, have a total steam capacity exceeding 6½ million lb per hr. This versatile B&W boiler is available in steam capacities ranging from 2900 to 28,000 lb per hr at pressures between 15 and 235 psi, suitable for a wide variety of industrial, utility, and other applications.

BABCOCK & WILCOX
BOILER DIVISION

Write for Bulletin G-76, for an illustrated, detailed description of the many other cost-saving features of this unique unit, The Babcock & Wilcox Company, Boiler Division, 161 E. 42nd St., New York 17, N. Y.

G-603

For more data circle 540 on Post Card

Revolutionary Performance!

Riley Boiler Unit gives bonus of 20,000 pounds per hour of steam to Masonite Corporation

Here's the maximum capacity guaranteed to Masonite by Riley Stoker Corporation:

50,000 lb. continuous
60,000 lb. for 15 min. peaks

And here's the Masonite report on performance: "For the past 75 days the average hourly load on the new boiler has been 70,000 pounds with peaks of one and more hours' duration of 75,000 pounds."

This same installation called for a guaranteed air heater gas temperature not in excess of 395 degrees at 50,000 pounds of steam per hour. In actual operation at 54,500 pounds of steam per hour, the air heater exit gas temperature was only 377.5 degrees!

No wonder Riley Stoker Corporation, Worcester, Massachusetts, is so well known among leading plants throughout the nation for the highly efficient performance of its boilers!

Coppus-Dennis FANMIX Burners Were Installed

To assure such revolutionary performance, Riley specified Coppus-Dennis FANMIX Burners for its boilers. The exclusive FANMIX action — on *all* Coppus burners, gas as well as combination gas-oil — is the reason for such performances.

FANMIX : Better Combustion : Better Efficiency : Higher Ratings

FANMIX burners, with their *revolving orifices*, give violent mechanical mixing and agitation of gas and air and, therefore, instantaneous and complete combustion with *minimum excess air* (5% excess air not unusual).

Furnace space is not required for mixing; therefore, *higher boiler ratings* are easily obtained.

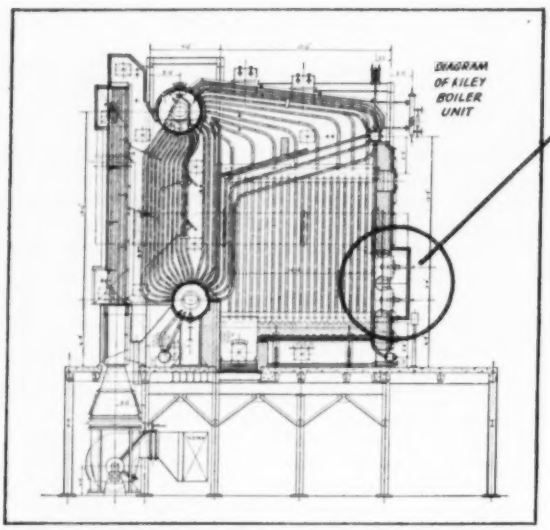
FANMIX burners, with shorter flame than any other burner, cannot cause flame impingement.

FANMIX burners, incorporating a *fan* as an integral unit, have *no draft loss* across the burner. Therefore, regardless of draft conditions, increased ratings are possible.

FANMIX action, with its quick completion of combustion, gives *lower* exit gas temperatures.

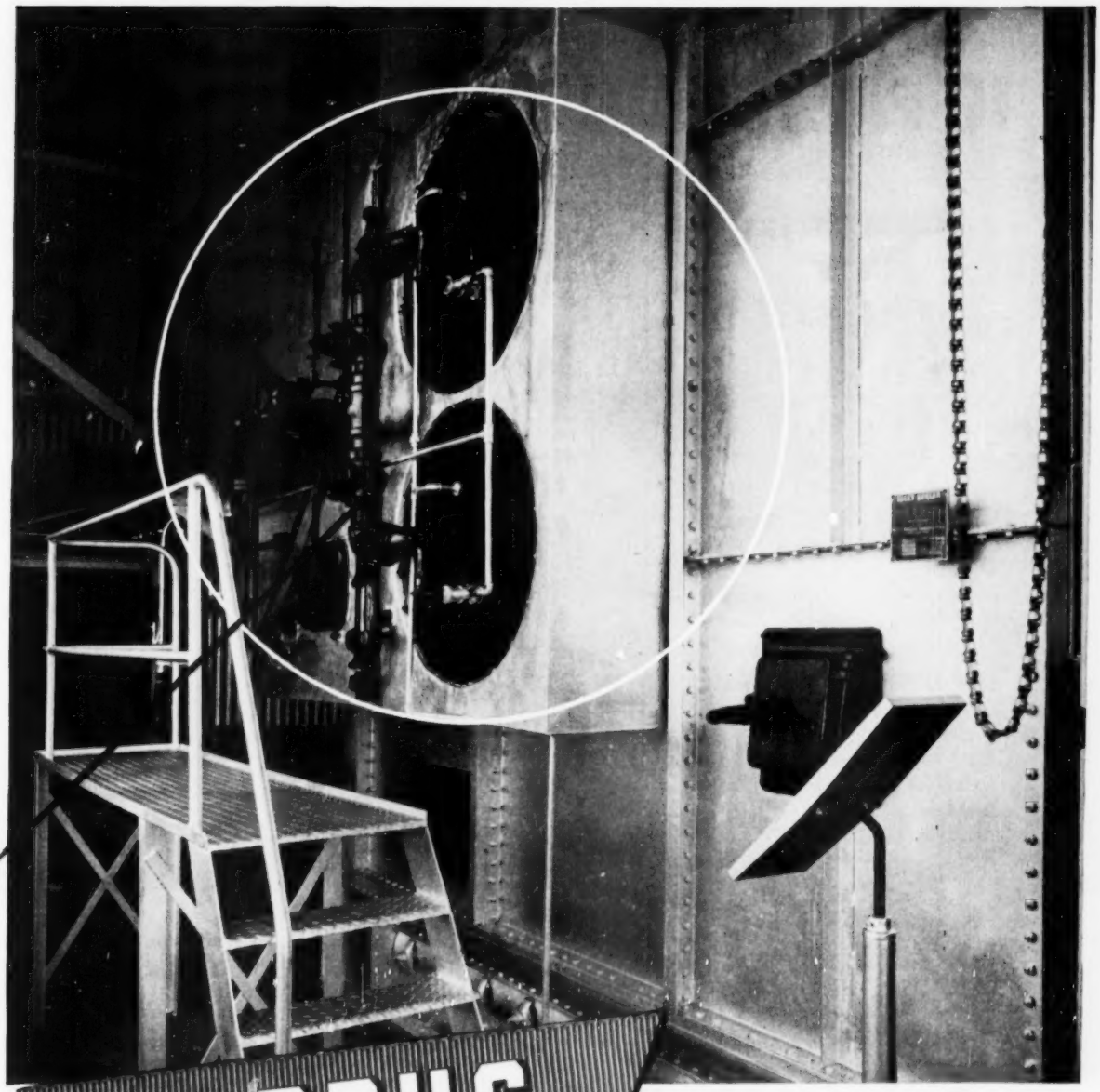
Plan now to take advantage of Coppus-Dennis FANMIX action with your present boiler. Remember — no forced draft equipment nor increase in stack nor increase in furnace volume is required for *FANMIX* operation to get increased capacity. And on *new* boilers, FANMIX lets you plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity, and *no* forced draft equipment. Mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory, and Mining Catalogs.*

JET REACTION is utilized to rotate fan which is integral part of burner. Automatically proportioned high velocity air passes at right angles through fuel to create ideal mixture for fast, complete combustion and peak efficiency.



Well-Known Users of Riley Units with FANMIX Burners Include:

Publicker Commercial Alcohol Co.
Monsanto Chemical Co.
Gaylord Container Corp.
Commercial Solvents Corp.
Celanese Corp. of America
Gulf Power Co.
Mississippi Power Co.
Eagle-Picher Lead Co.
Humble Oil & Refining Co.
Godchaux Sugars, Inc.
Kennecott Copper Corp.
Nicholson File Co.
Bird & Son, Inc.
— and many others



RILEY BOILER UNIT, using FANMIX burners, is here shown as installed for the Masonite Corporation, Laurel, Mississippi. Circle in diagram at left indicates position of burners pictured above.

SEND COUPON for further information. Coppus engineers FANMIX burners to your individual requirements.

PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION
170 Park Avenue
Worcester 2, Massachusetts

Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in
☐ gas ☐ combination gas-oil.

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

For more data circle 541 on Post Card

10 FACTS YOU SHOULD KNOW

ABOUT

600# HANCOCK STEEL WELDVALVES

GLOBE AND ANGLE

600# HANCOCK STEEL WELDVALVES, in globe and angle types, are built for all pressures up to 850 psi at 750°F— O.W.G. 2000#, 100°F. **Screwed and socket weld ends** available on sizes from ¼" through 2". **Flanged ends** on sizes from ⅛" through 2".

You can't buy another 600# valve that can do as good a job as these Hancock Weldvalves. Their unique construction, precision manufacture, and high quality components eliminate or neutralize all major sources of trouble. Convince yourself. Study these reasons why 600# Hancock Weldvalves serve better and longer:

1. **BONNET JOINT ELIMINATED.** No gasket to blow. No bonnet joint to leak.
2. **NO SEAT RING JOINT TO LEAK.** Lifetime integral seat has a 420 Brinnel cobalt chromium tungsten alloy facing. Disc is 500 Brinnel stainless steel. Both are accurately finished, perfectly aligned —won't leak. No wire drawing, galling, steam cutting, erosion or corrosion.
3. **PACKING THAT'S "TOPS".** Ideal for temperatures up to 850°F. Made of finest quality long fibre yarn. Plastic core is extruded when braided wire inserted jacket is woven around it. Binder in the core is highly compressed—packing shrinkage is only 5%. Zinc dust inhibitor helps prevent stem pitting. Repacking is simple—packing gland flange can be swung out of the way, leaving both hands free to work.
4. **NON-PITTING STEM.** 300 Brinnel chrome stainless steel—not affected by electrolytic action.
5. **NON-FREEZING BALL RACE JOINT.** Stainless steel ball bearing stem-to-disc connection assures even load distribution, easy operation, corrosion resistance, longer service.
6. **CORROSION RESISTANT BACK SEATING.** Stuffing box can be shut off around the stem with the valve fully open.
7. **NO NON-WORKING THREADS ON STUDS.** All studs are chromized—equivalent to 18-8 stainless steel. Non-corrosive—always workable.
8. **BUILT EXTRA STRONG TO LAST.** Carbon steel body is suitable for 700# and 850°F. service. Maximum use of welding adds strength. Upper structure is far more rugged than conventional designs.
9. **EASY TO INSTALL IN TIGHT SPOTS.** Space-saving compactness permits close alignment of piping with near structures. 30 to 60% less weight makes handling easier. Flanged ends simplify installation of sizes ½" and larger where space is extremely limited. Packing glands can be readily pulled tight in close quarters.
10. **ECONOMICAL TO MAINTAIN.** Fewer parts, the finest quality packing, repacking ease, every practical use of stainless steel, corrosion resistant treatment of the entire valve—all assure low-cost, long-life service.

All these advantages are yours when you invest in 600# Hancock Steel Weldvalves. Yet they are priced right in line with ordinary valves. Your Hancock Valve Distributor is as close as your telephone. Get complete specification and operational data — phone him today.

When Hancocks go in, valve costs go down

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the facilities and experience to serve you efficiently and economically. He banks his reputation on the quality of the products he sells. You can depend on him for sound recommendations and prompt deliveries from local stocks.

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

For more data circle 542 on Post Card

STANDARD HD
TRADE MARK
OIL

Running up record ring life with . . .

● In 1947, operators of a midwest municipal power plant put a new 1060-hp diesel unit into service, using STANDARD HD Oil for lubrication.

After 19,000 hours' operation, the unit was shut down for inspection. The engine was entirely free from deposits and showed minimum wear. Piston rings were in excellent condition and were replaced in the engine for further service. This unit is still going strong with a total of 23,000 hours of trouble-free operation on its original piston rings.

Installed in 1950, a 1755-hp, supercharged diesel engine in this plant is running up another record for low maintenance with STANDARD HD. After more than 9,000 hours' operation, this unit was inspected and found unusually clean. Rings were free, and it was not necessary to remove them for cleaning purposes.

The outstanding performance of STANDARD HD Oil in all types of diesel-generating installations provides the evidence of the benefits it can bring in your diesel units. The Standard Oil lubrication specialist serving your immediate area of the Midwest will be glad to give you this evidence, using plants with which you may be familiar. Phone your local Standard Oil office. Or write: Standard Oil Co., 910 S. Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY

STANDARD

(Indiana)

With G-E vertical lift, you can see when the breaker disconnects

Maximum safety to operator and equipment is provided. Mechanically operated shutters of insulating material close off disconnect openings when breaker is lowered. Stationary contacts are never exposed, present no safety hazard. Shutters open as breaker is raised, permitting entrance of breaker studs.

On G-E Metal-clad Switchgear—

1876 75 1951 YEARS OF ELECTRICAL PROGRESS

New safer, fast-action elevating mechanism can raise or lower breaker in 30 seconds

Vertical-lift design isolates breaker, simplifies inspection

Smooth, practically effortless raising or lowering of the breaker in General Electric's improved metal-clad switchgear, whether for inspection or test . . .

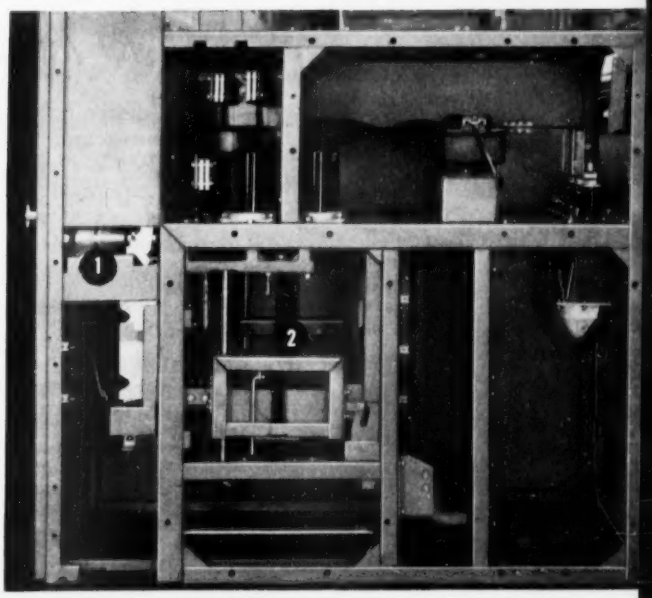
That is what you get with one of the simplest elevating mechanisms possible for the job: two jack screws—a sturdy cross chain drive—a compact gear motor with operating switches.

POSITIVE-ACTING MECHANICAL INTERLOCKS assure speedier operation. An interlocking system effectively blocks raising or lowering a "closed" breaker. In the operating position, the circuit breaker is locked in, preventing downward movement caused by even the most severe vibration. All parts of the elevating mechanism are accessible at front of the compartment, with the motor easily demountable for hand-crank operation.

BESIDES THESE ADVANTAGES of the new, faster-acting breaker-elevating mechanism, you also get full benefits of G.E.'s basic vertical-lift design. You can—

- See when breaker is isolated and breaker studs separated from main stationary contacts. Mechanically operated shutters close off disconnect openings to protect operator.
- Close the door with breaker in lowered position.
- Make most inspections and tests with breaker just lowered—not removed from compartment.
- Save time and energy, as mechanical lift makes removal of breakers convenient and easy.
- Gain quick, easy access to breakers in outdoor installations—especially on roofs where catwalks make other types of breaker removal inconvenient.

FOR THE COMPLETE STORY on G-E Vertical-lift Metal-clad switchgear, with ratings up to 13.8 kv, 500 mva, write for GEA-5664-A, Sect. 874-4, General Electric Company, Schenectady 5, N. Y.

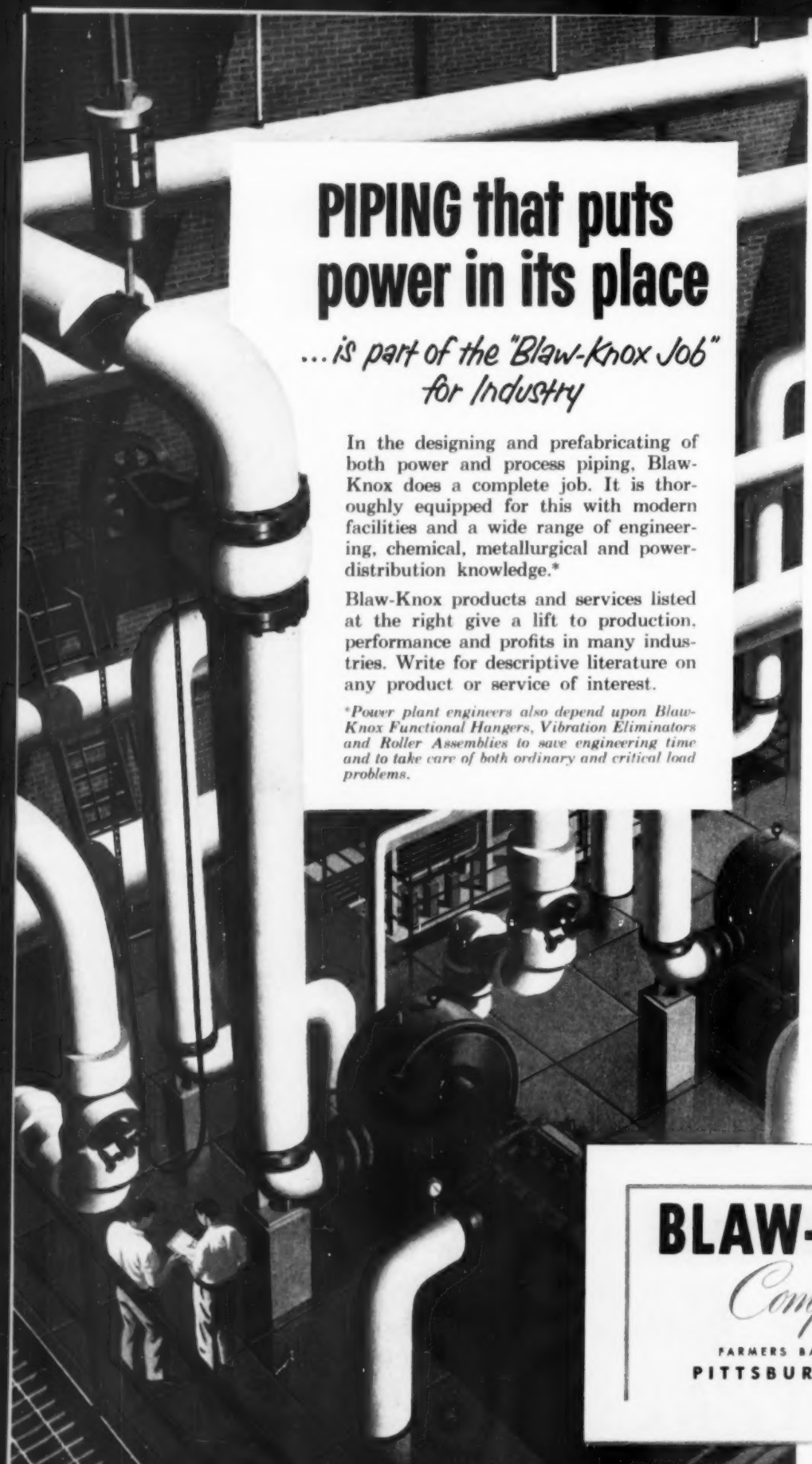


NEW ELEVATING MECHANISM is shown in breaker with side plates removed. Compact gear-motor (1) in front of the compartment drives simplified jack screw mechanism (2) to raise breaker.

VERTICAL-LIFT DESIGN proves invaluable in outdoor switchgear installations—enables personnel to disconnect and inspect breakers easily in spite of gravel or other obstacles.

You can put your confidence in—

GENERAL ELECTRIC



PIPING that puts power in its place

...is part of the "Blaw-Knox Job" for Industry

In the designing and prefabricating of both power and process piping, Blaw-Knox does a complete job. It is thoroughly equipped for this with modern facilities and a wide range of engineering, chemical, metallurgical and power-distribution knowledge.*

Blaw-Knox products and services listed at the right give a lift to production, performance and profits in many industries. Write for descriptive literature on any product or service of interest.

**Power plant engineers also depend upon Blaw-Knox Functional Hangers, Vibration Eliminators and Roller Assemblies to save engineering time and to take care of both ordinary and critical load problems.*

MEMBERS OF THE BLAW-KNOX "FAMILY" AND SOME OF THEIR PRODUCTS

Blaw-Knox Equipment Division
Blawnox, Pa.
- Concrete Road Paving Machinery
- Clamshell Buckets
- Contractors Equipment
- Gas Cleaning Equipment
- Open Steel Flooring
- Radio, TV and Transmission Towers
- Steel Forms for Concrete Construction
- Chemical and Process Equipment
- Water Cooled Equipment for High Temperature Furnaces

Buflovak Equipment Division
Buffalo 11, New York and Mora, Minn.
- Machinery for the Chemical and Food Processing Industries
- Specialized Machinery for the Dairy Industry

Chemical Plants Division
Pittsburgh 30, Pa.
- Complete Chemical, Petrochemical, Industrial and Petroleum Plants

Foote Construction Equipment Division
Nunda, New York
- Black Top Road Pavers
- Concrete Road Pavers

Lewis Machinery Division
Groveton, Pa.
- Rolling Mills and Auxiliary Machinery for Rolling Ferrous and Non-Ferrous Metals

National Alloy Division
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120-V Nicad Batteries Power A-C, D-C Switchgear

Three Nicad batteries at General Cable's Perth Amboy plant have saved over $500 annually in maintenance costs alone. They operate switchgear independent of power supply

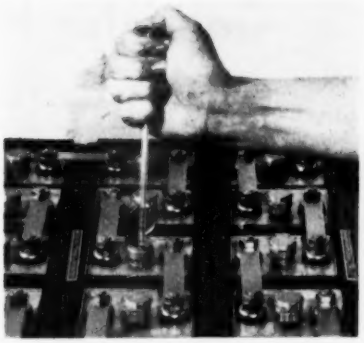

Fig. 1. Simplified checking at long intervals is major reason for low cost of operating batteries

ADOPTION of three nickel-cadmium alkaline batteries for switchgear operation is saving General Cable Corp's. Perth Amboy, N. J., electric cable producing plant over $500 each year in battery maintenance costs. Installed in 1949, these Nicad batteries have required checking of the electrolyte level only once every three months. Lead-acid storage batteries, formerly used, required checking of the electrolyte level and the specific gravity at weekly intervals.

General Cable's 2300-volt, 3-phase, 60-cycle power is purchased from Public Service Co. of New Jersey and direct current for variable speed drives is generated in the plant by electric motor-driven generators. The three Nicad batteries operate both the a-c and the d-c switchgear. Equipped with fully automatic trickle chargers, which normally carry the operative load, the batteries "float" on the line and provide for switchgear operation even in the event of a total power failure.

Dry-type, half wave rectifier chargers which operate at 131 volts are used. This is 1.38 volts per cell for each of the 95 cells that make up each 120-volt battery. As the cells will not "gas" below 1.47 volts, there is no loss of electrolyte due to charging. To protect against charger failure, or the inadvertent switching off of the charger, each battery has been equipped with a low-voltage alarm which will ring a bell if the total voltage drops to 112 volts.

Locate Batteries Near Load

One of the batteries is located in the boiler house and operates the switchgear that controls the various boiler auxiliaries. Although the ambient temperature at this particular installation may reach 110 F in the summer months, no noticeable increase has been observed in the normally low water consumption of the Nicad battery. Contributing to the low water consumption is the fact that the electrolyte is covered with a ¼-in. layer of acid-free mineral oil.

Two other batteries are located in manufacturing buildings and it is interesting to note that no special provisions had to be made for their installation. Because of the fact that the nickel-cadmium battery does not gas at normal charging or discharge rates and because the electrolyte is alkaline, rather than acid, there are no dangerous fumes to be vented. Painted walls of the building interior and the clothes of the workers who may inadvertently brush against the battery trays are all safe from corrosive attack.

Maintenance savings evolve chiefly from the fact that a check of the electrolyte level once every three months is sufficient. Additional savings in time and money accrue from the fact that only five or six "pilot" cells of the Nicad battery have to be checked, whereas all 54 cells in an equivalent lead-acid battery would have to be checked. Still another time-saver is the fact that the cell caps of the Nicad battery are spring loaded and can be released with a flick of the finger.

Electrolyte Checking

Checking the electrolyte is very simple and requires only a glass tube about 6 in. long and ¼ in. in diameter. The tube is open at both ends and, in use, is inserted in the cell to be checked. When the tube bottoms on the top of the steel plates, the electrician puts his thumb over the upper end and removes the tube.

The electrolyte level in the tube will be the same as the level in the cell and as long as this is between ½ in. and 1⅛ in., no water need be added. Lines are etched on the tube to facilitate the checking operation. Removing the thumb from the upper end of the tube permits the electrolyte to flow back into the cell. Snapping the hinged, spring loaded cap back into place completes the operation. A cell can be checked in 20 seconds and not more than three minutes is required to check the five or six pilot cells of a 120-volt battery.

The electrolyte is a solution of pure caustic potash (KOH) in distilled water and has a normal specific gravity of 1.210. For all practical purposes there is no change in the density of the electrolyte under normal operating conditions and, consequently, it is not necessary to take hydrometer readings or keep specific gravity records. Cell voltage readings may be taken occasionally but, in the case of the General Cable installation, this has been done only once in the 3½ years that the batteries have been in service.

Yearly maintenance savings in excess of $500 are conservative and are based upon the "estimating"

(*Continued on page 126*)

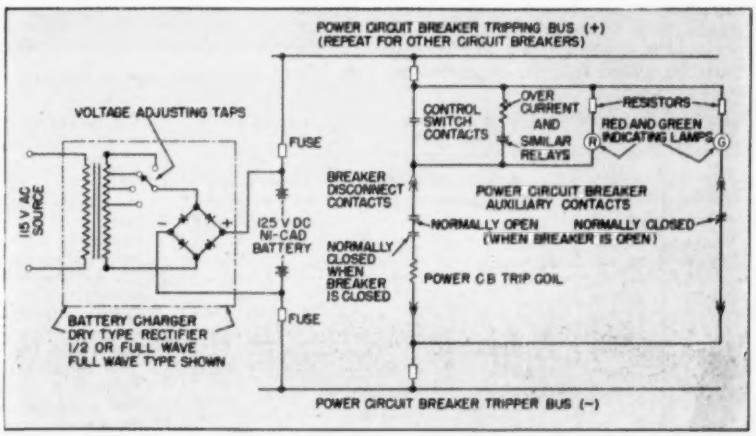

Fig. 2. Wiring diagram of the nickel-cadmium battery installation at General Cable's Perth Amboy plant

Costs for Handling Coal from Cars to Storage

Maintaining a steady flow of coal into the plant at low handling cost presents a different problem in each plant. This study helps solve the cost-reliability problems in your plant

By **WILBUR G. HUDSON**

Consulting Engineer

GENERAL USE of small bituminous coal (minus ½ in.) in steam plants has long meant headaches to engineers responsible for the material handling layouts. This is due to its reluctance or downright refusal to flow when its surface moisture exceeds certain critical limits, or when it is frozen.

Trouble starts right in the car, especially if shipments have been exposed to freezing temperatures in transit. Otherwise, one or another of the car-shakers available gets us past this point. Manual unloading takes two men an hour or more to empty a 50-ton car of ¼-in. dry slack. When it is wet it takes three men at least two hours, with considerable spading out. When it is frozen, it must be thawed before spading.

Good reports have been received about a radiant-heat thawing device (Fig. 1) where only a few cars per week are involved. A firebrick box is placed ahead of the track hopper between ties. Low-pressure venturi burners maintain opposed flame jets in the box, and the heat is radiated upward against the car hoppers. When not needed the box is covered by a metal plate. The manufacturers claim that a thoroughly frozen load can be thawed in ½ hour with a fuel consumption of 9 to 12 gal of oil or the equivalent in gas at a cost of about $1 per car. It may be desirable to have two or more units spaced so that the heat is generated directly beneath each car hopper. The approximate cost for a single unit, where 20 to 25 cu ft of air at 60 psi pressure is available, is $500. To this must be added freight, concrete pit, piping, and installation costs which will bring the total cost of a single unit installation to around $1800.

Where the volume is greater, the car-shaker is the accepted equipment. The Link Belt Co. reports the following test results with their machine:

Car Type and Capacity	Coal Size and Condition	Unloading Time
C & O, 50 ton, 3 hoppers	½ in. by 0, partly frozen. Much slack	1¼ min
C & O, 50 ton, 3 hoppers	¼ in. by 0, wet. Frozen crust.	1 min
C & O, 50 ton, 2 hoppers	Slack, bug dust, wet. Partly frozen.	7 min

Investment in a car-shaker is too much for the smaller plants. The unit costs around $7000 and the supporting structure doubles that figure.

After the coal has cleared the car, there is not much difficulty in getting it to the bunker; however, the long-standardized track hopper with sides sloped at 45 deg (which means valley

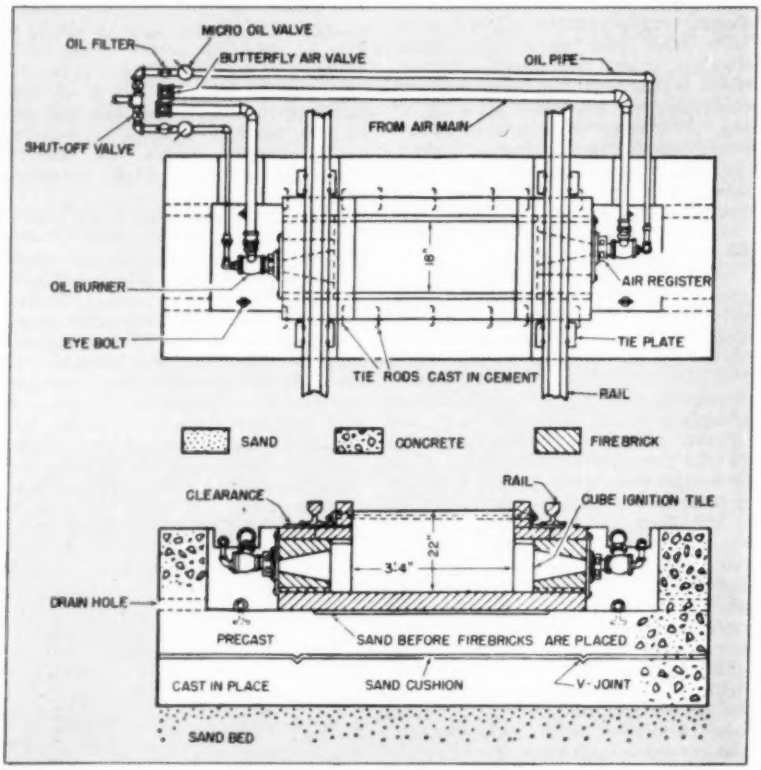

Fig. 1. Oil burning radiant-heat car thawing device expedites unloading of coal from ice-locked cars

Table I. Labor costs for handling coal at plants using 40M to 172M tons yr

Station	Kilowatt Capacity	Tons per Year	No. of Handlers	Annual Cost	Labor Cost per Ton, cents
A	14,250	39,900	2	$ 3,000	7.7
B	31,000	88,600	3	4,500	5.0
C	20,000	71,500	3	4,500	6.0
D	23,500	55,800	4	6,000	25.5
E	72,500	118,365	6	9,000	8.05
F	74,500	86,500	7	10,500	12.20
G	53,000	43,700	8	12,000	28.0
H	55,000	154,500	9	13,500	8.7
I	65,000	172,000	14	21,000	12.2
				Average	12.6 cents

Table II. Breakdown of the production costs for Station H listed in Table I

Net kilowatt output	350,400,000	
Fuel cost	$769,400	
Fuel cost per kilowatt-hour	0.220	cents
Labor and supplies	$74,200	
Cost per kilowatt-hour output	0.0121	cents
Maintenance	$117,600	
Cost per kilowatt-hour output	0.033	cents
Coal cost per ton	$4.90	
Pounds of coal per kilowatt-hour	0.896	
Total coal consumed	157,046	tons
Total annual charge for handling coal	$38,000	
Total production cost	$961,300	
Cost per kilowatt-hour output	0.274	cents

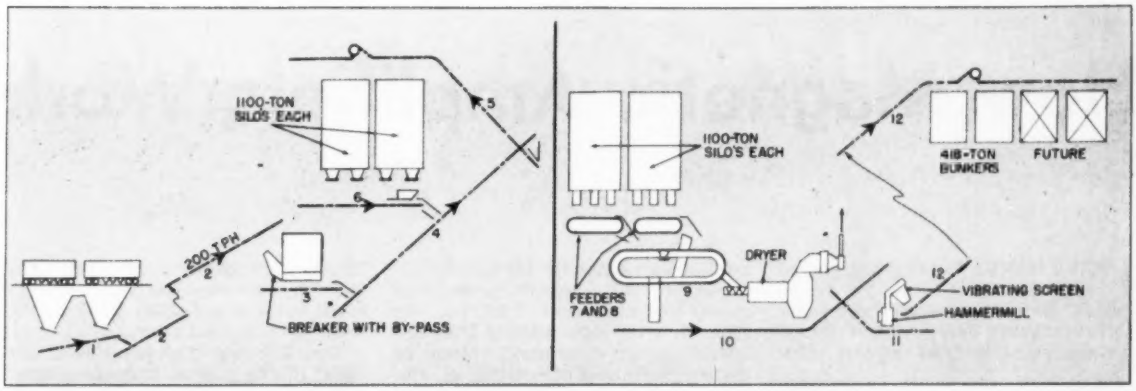

Fig. 2. Two stages of coal handling are features of Dow Chemical Co.'s South Power Plant, Midland, Michigan. First stage carries coal through breaker to silos. Second stage carries coal from silos through screen, hammermill and rotary dryer to the boiler house bunker. Belt conveyors are utilized by both stages

or corner slopes of 36 deg) will not clear. It helps if the valley slopes can be made not less than 45 deg, which, for a square hopper, means sides sloped at 55 deg.

None of the standard high capacity elevators and conveyors have much trouble with damp coal, but when it gets into a storage silo or bunker, it packs badly if the surface moisture exceeds 6 per cent. Usually it flows freely if the surface moisture is 4 per cent or less. In theory we might eliminate the difficulty with wet small coal by purchasing and crushing lump coal. Three-in. lump coal has a surface area of 500 sq ft per ton. If these lumps are crushed to minus $\frac{3}{4}$ in., the exposed area becomes about 4000 sq ft per ton, and all the freshly exposed areas have a surface moisture about the same as the internal moisture content. Since this is negligible, the average resultant surface moisture of the crushed product is well below the degree at which the coal will flow freely.

This procedure, however, is handicapped by the element of cost. When the cost of raw small sizes is $3.10, or washed about $4.85 per ton, large coal (say 6 x 3 lump) will run about $4.90 per ton. The cost of crushing must be added to that cost. One solution is to supply $1\frac{1}{2}$ in. slack, which is reasonably flowable, store it and crush it at say 40 to 60 tph and pass it to the service bunkers at that rate. A dryer installation with sufficient capacity to dry coal at the usual incoming rate (150–200 tph) runs into considerable money.

Coal Handling at Dow

What is probably the first move in this direction is that by the Dow Chemical Co. in their 800,000 lb per hr South Power Station. It is situated in a section where winter conditions are, to put it mildly, rugged. Incoming coal is $1\frac{1}{2}$ in. slack and at times it must be thawed to loosen it in the cars. Surface moisture must be reduced substantially to insure free flow since the boilers are equipped with cyclone burners which require an uninterrupted feed of minus $\frac{1}{4}$ in. coal.

Reserve ground storage is maintained at a distant waterside area where coal is discharged by self-unloading vessels. Here it is spread and compacted by bulldozer and carry-all, and loaded in cars as required for the plant. At the plant, if the contents are more or less frozen, the cars are placed within a firebrick-lined thawing station which accommodates four 70-ton or six 50-ton cars. Remote-controlled gas burners spaced 3 ft apart are mounted in a shielded trench outside the rails. The cars are spotted for thawing by a fireless locomotive, and 15 or 20 minutes suffice to soften coal adhering to the car sides and bottoms. The cars are then shifted in pairs to twin track hoppers where a shaker is lowered into place, and they are cleared without manual labor. In an 8-hr shift, 20 or more cars may be unloaded.

Fig. 3 illustrates diagrammatically the further coal movement. The $1\frac{1}{2}$-in. slack moves from the track hoppers at 200 tph on belt conveyor (1), onto conveyor (2) and into a Bradford breaker to cull out foreign material. From the breakers, conveyors (3), (4) and (5) take the coal to twin 1100-ton capacity storage silos. Coal $1\frac{1}{2}$ x 0 will ordinarily feed from the silos through one or more discharge openings to apron feeders (7) and (8). The coal moves on to flight conveyor (9), the top run of which discharges to the dryer feeder. The lower run discharges to flight conveyor (10) if drying is not required. Conveyor (10) discharges to a vibrating screen from which the required minus $\frac{1}{4}$ in. size is carried by conveyor (12) to the two service bunkers. Oversize passes through a hammermill and, by conveyor (11) back to conveyor (10) for re-screening through the vibrating screen.

Rotary Coal Dryer

When the coal from the silos does require drying, it is passed as stated from conveyor (9) to a rotary 11 ft x 36 ft dryer with a wet-feed (15 per

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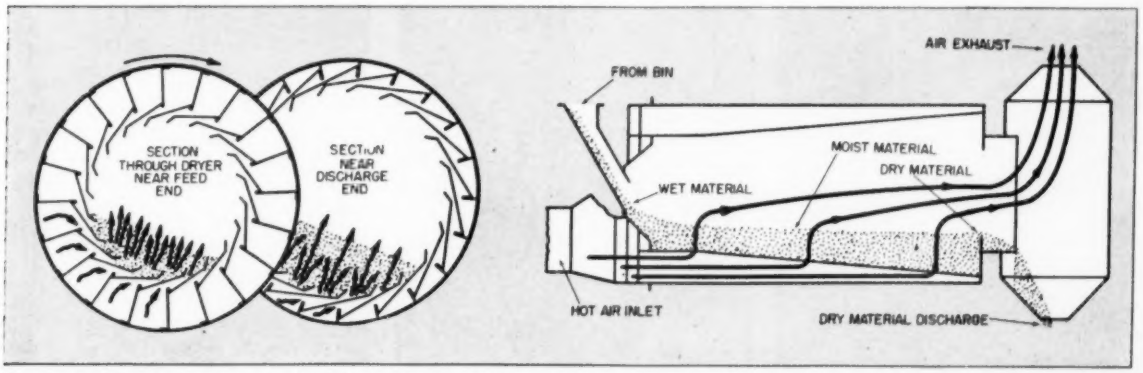


Fig. 3. Rotary dryer blows hot air or gas inward through the coal bed as it feeds toward the discharge end. Louvres admit hot air along full length of dryer

How Magnetic Amplifiers Work...

FEW THINGS have made a greater contribution to our enormous industrial output than automatic control. Nearly every control system includes some form of regulator that uses small voltage or current signals to control other quantities such as speed, torque, tension, position, etc. Part of most regulators is a device for amplifying these small voltage or current signals. Three types of amplifier dominate the field today: rotating, electronic, and magnetic. The magnetic amplifier is growing fast and taking over more and more of the field. Not only can it do most jobs as well as the others, but it has the additional advantages of being robust and reliable, it can be packaged and hermetically sealed, it has no moving parts, no fragile tubes, and needs practically no maintenance.

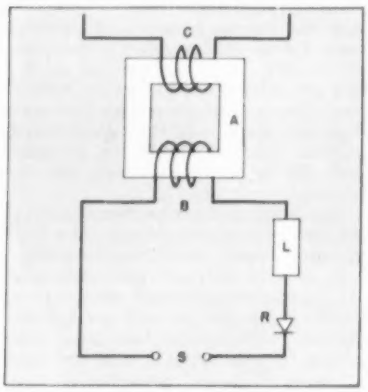


Fig. 1. Simple magnetic amplifier circuit diagram

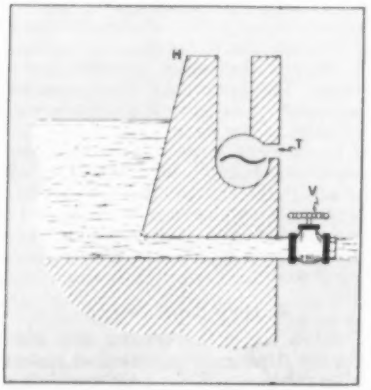


Fig. 2. Hydraulic analogy for magnetic amplifier

Fundamental Principles

There has been plenty of writing in recent years about magnetic amplifiers, and their construction, characteristics, and applications have been described in detail; but it always seems to be taken for granted that everyone knows how they work. Those, however, who are not familiar with the fundamental principles of magamp operation may be interested in this hydraulic analogy, given by Dr. R. A. Ramey, manager, Magnetic Development Section, Materials Engineering Department of Westinghouse Electric Corp. at a recent Magnetic Amplifier Symposium held in New York.

Figure 1 shows a schematic diagram of a simple magnetic amplifier circuit. A is the amplifier core, B the main winding, L the load, R a rectifier, and S the a-c power supply. C is a d-c control winding on the magnetic core.

Figure 2 is a diagram to illustrate the operation of the magamp. H represents a dam with water behind it. When water flows over the crest of the dam it operates a turbine T; when valve V is opened it lowers the water level behind the dam.

Consider first the operation of the dam. Starting with it quite empty, and the valve closed, as in Fig. 3, suppose the rain falls according to curve in Fig. 4, with all the rain falling during the day and none at night, and this cycle is repeated every 24 hours. By the end of the first day, i.e., at point B in Fig. 4, the water level behind the dam would have risen to point H in Fig. 5. Then let us suppose that during the night, when no rain is falling, we open valve V and let out all the water, so that by the time the rain starts again next morning the dam is empty again and the whole day's rain just fills up the space behind the dam without flowing over the crest. Each day and night the cycle is repeated, so no water flows over the crest to work the turbine.

Effect of Core Saturation

Now let us suppose that at the end of the first day's rain, instead of opening the valve and letting all the water out, we open it enough to let out only half, so that at the end of the first night the level will be at M in Fig. 6. Next day half the rainfall will fill the dam and the rest will flow over the crest and work the turbine, as shown in Fig. 7.

If we don't open the valve at all, so that at the end of the first night the level remains at H (Fig. 5), next day all the rainfall will flow through the turbine.

Thus we have amplified the small amount of energy needed to operate the valve to control the larger flow of power used to drive the turbine.

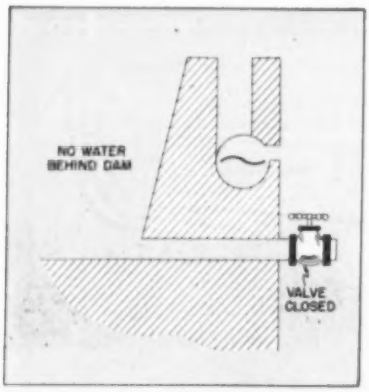


Fig. 3. Represents magnetic core when unsaturated

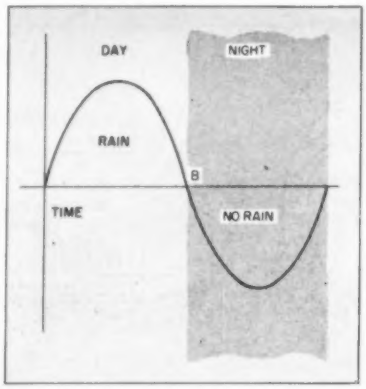


Fig. 4. Diagram shows daily variation of rainfall

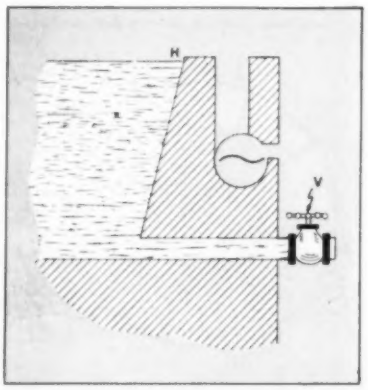


Fig. 5. Represents fully saturated magnetic core

...A Simple Hydraulic Analogy

In the magnetic amplifier circuit shown in Fig. 1, current flowing through the load L corresponds to the water flowing through the turbine, and the control winding C corresponds to the valve V. Before describing its operation, we must be clear about an important characteristic of this type of circuit. If the core A is unsaturated, then winding B will have a high reactance, since any change of current in the winding produces a change of flux in the core, and this change of flux induces a back E.M.F. in the winding that gives it a high reactance. In other words, when the core is unsaturated, the reactance of B will be high, and practically no current will be able to flow through it or the load.

On the other hand, when the core is saturated, a change of current in B has practically no effect on the flux in the core, and since there is no change of flux there is no reactance, and so the reactance of B is negligible and a large load current can flow through B and the load.

How the Amplifier Works

Applying this principle to the magamp circuit in Fig. 1, assume the circuit voltage varies as shown in Fig. 8, and that we start with a completely unsaturated core. In the first half cycle (A to B in Fig. 8) the core is unsaturated and the reactance of winding B is high so only a very small current flows in the load circuit. At the end of the first half cycle (point B in Fig. 8) the core will be partially saturated by this small current, but in the second half cycle, B-C in Fig. 8, during which no current flows because of the rectifier in the power circuit, we apply a control current that unsaturates the core, so that by the time the next half cycle comes round again the core is unsaturated, and once again no large load current can flow. This application of the control current corresponds to the opening of the valve at the dam.

If on the other hand we do not apply any control current, after a few cycles the core will become saturated by the small load current flowing through the high reactance of winding B, and once the core is saturated, B's reactance will drop, and a large load current will flow in the circuit. Thus, with a small control current we can control large amounts of power in the load circuit. Commercial amplifier circuits naturally are more complicated than the simple one explained here, but the fundamental principles remain the same however complicated the development.

Special Magnetic Steels

Not only do we want to control large loads with small control currents, but we also want the response to be very rapid. Though magnetic amplifiers have been built for years, it is only recently that the quality of material has given them an amplification and speed of response that enables them to compete with other types of amplifier.

This point is illustrated by comparing the hysterisis loop for an old type of magnetic steel as shown in Fig. 10 with the loop in Fig. 9 which is for one of the new types of magnetic steel used for modern amplifiers. Referring to Fig. 10 it will be seen that to saturate the steel, large magnetizing current, XZ, is needed, compared with the small current AB needed to saturate the steel in Fig. 9. Also, the rate of saturation, as indicated by the slope of the line XP in Fig. 10 is much slower than the slope AC in Fig. 9, which shows how very small changes in magnetizing current will saturate or unsaturate the high performance steels very quickly.

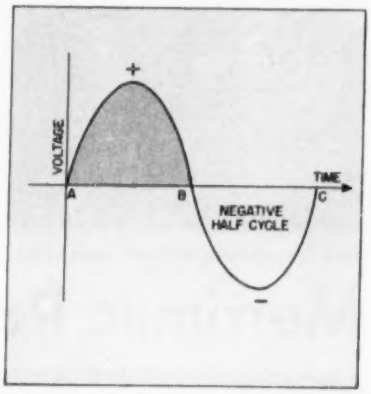


Fig. 8. Variation of magamp supply volts with time

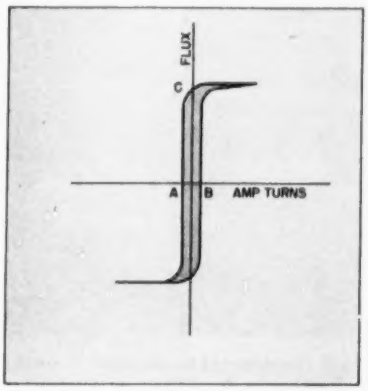


Fig. 9. B-H curve for a high performance material

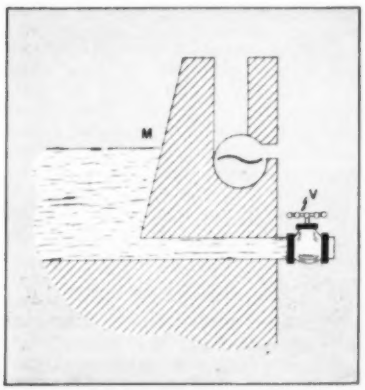


Fig. 6. Represents a half saturated magnetic core

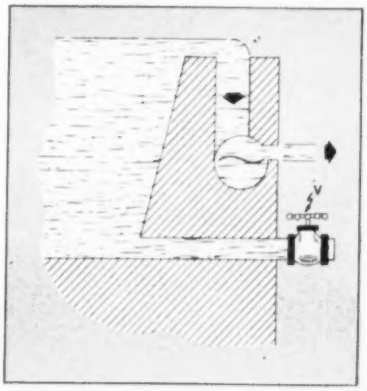


Fig. 7. Flow over dam corresponds to load current

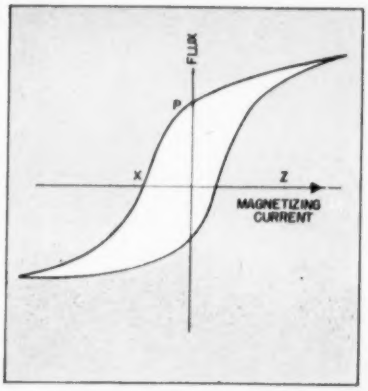


Fig. 10. B-H curve for a low performance material

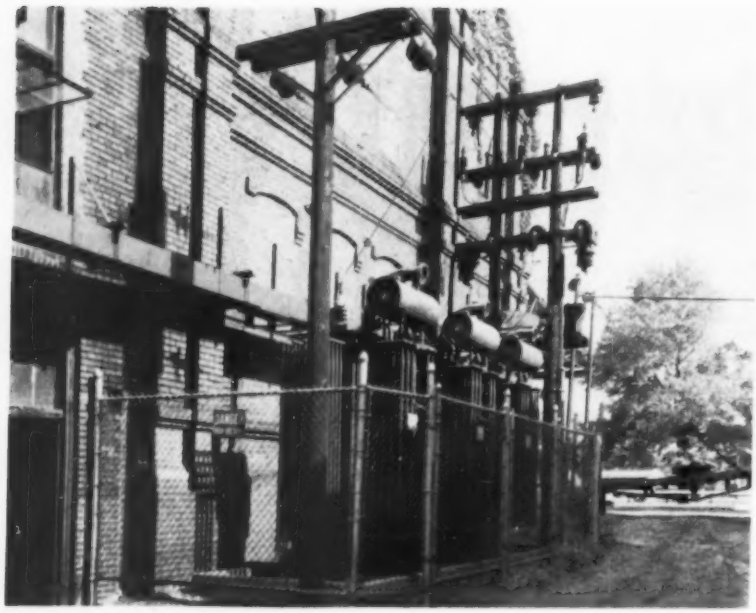


Fig. 1. From substation, purchased power at 575 v is delivered to Merrimac Paper Co. through bus ducts

First steps in program already taken by remodeling waterwheel generator, which operates in parallel with purchased power, and modernizing mill water filters, increasing their capacity and installing chlorination equipment. Future steps will include new 600-psi boiler and perhaps topping turbine on present steam turbine paper machine drives. Results will be lower power and steam costs, better operation, improved reliability

By L. B. ROGERS
Production Manager,
Merrimac Paper Co.

Merrimac Paper Co. Begins Long-Range

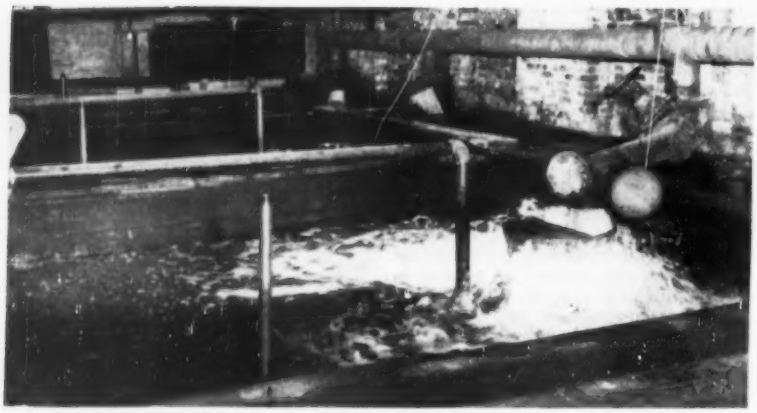


Fig. 2. Two sections of the remodeled four-section filter supplying 3,000,000 gpd of water for the mill

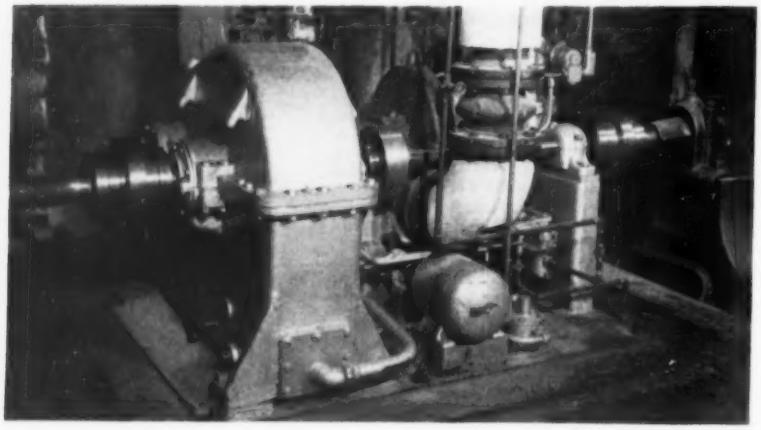


Fig. 3. This geared 175-hp steam turbine drives a paper machine, exhausts at 30 psi for paper drying

FIRST PART of a power modernization program, to be carried out within the next 4 or 5 years, has already been put into effect at the Merrimac Paper Co.'s mill at Lawrence, Mass. This mill manufactures kraft specialties — cover stock, base stock for paper converters, envelope stock, insulating papers (a very important item for manufacturers of power cable and electrical equipment) and other kraft products. The mill has a capacity of 50 tons a day of kraft specialties, manufactured from purchased pulp.

As in all paper mills, costs of steam and power at Merrimac must be held to a minimum, and the power and steam supply facilities must provide complete reliability and continuity of service. The modernization program is intended to enable the mill to meet these requirements even better than in the past and with ever-increasing ease and economy of operation.

Electric power for the mill has been and is now obtained by generating part of it with water power and purchasing the remainder. Two paper machines are driven by geared steam turbines, which supply exhaust steam for paper drying on the machines. Water for processes and boiler feed is Merrimac River water, drawn from the existing canal of the Essex Co. and filtered.

Purchased Power

Required electric power for the mill in excess of that generated is purchased from the Lawrence Gas & Electric Co., the local operating division of the New England Electric

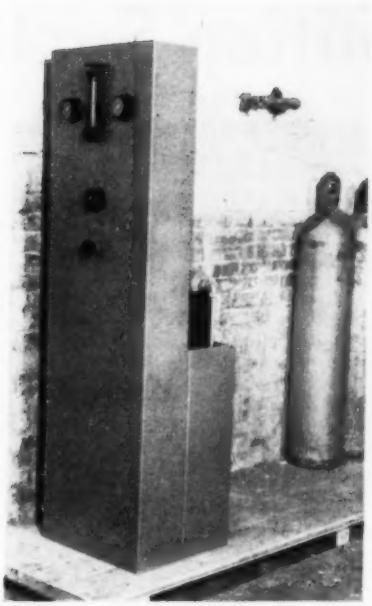


Fig. 4. New chlorinator for sterilizing all mill water

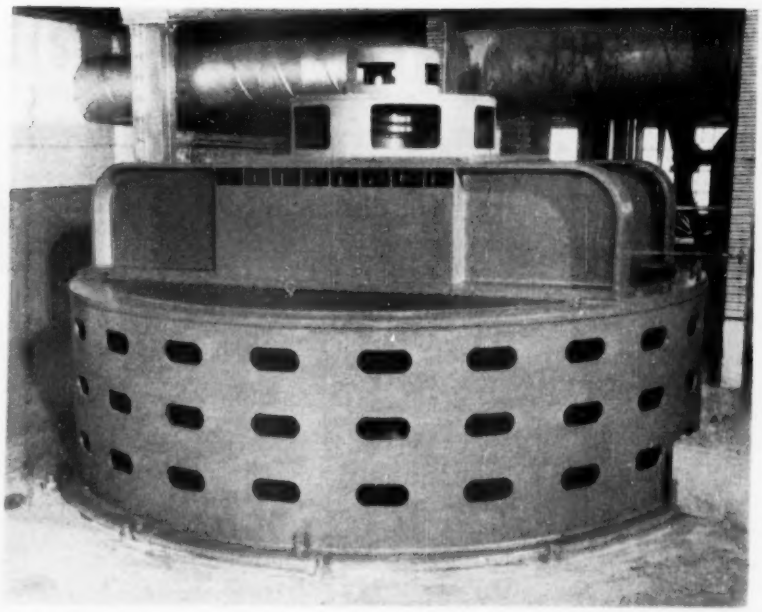


Fig. 5. New vertical generator and reconditioned water wheel have capacity of 750 kva at 0.85 pf

Electric Power Modernization

System. This power enters the plant through the substation of Fig. 1.

This substation was originally built by the utility and then was purchased by Merrimac Paper Co. It contains three General Electric oil-filled transformers, with related insulators, cable and wood pole construction as shown. The transformers are each rated at 833 kva, receiving power at 13,800 v from the utility transmission lines and stepping it down to 575 v for distribution through the mill. It is stepped down again to 110 v for lighting circuits.

Power from the substation is conducted to the mill switchboards by means of Westinghouse bus ducts and on the boards is paralleled with the power from the water-wheel generators.

New Water-Wheel Generator

One of the first steps to be completed in the power modernization program has been the remodeling of one of the water-wheel generators. The existing hydraulic turbine of this unit is an S. Morgan Smith vertical-shaft turbine, formerly equipped with a lignum vitae step bearing and belted to an electric generator.

Recently this turbine was completely overhauled by S. Morgan Smith and re-installed with a new direct-connected vertical-shaft generator, Fig. 5. This is an Electric Machinery Mfg. Co. 750-kva, 0.85-pf, 600-v, 60-cycle, 164-rpm unit. The turbine operates at 27-ft. head. The modernized unit has been equipped with a Kingsbury thrust bearing, located at the top of the generator at the level of the top horizontal frame members. In operation, this thrust bearing supports the generator rotor, the water wheel and the entire shaft, with steady bearings on the shaft as required.

An automatic hydraulic oil system is provided for lifting the rotating parts during starting and for applying brakes in stopping the unit, while a separate oil pump supplies oil for the Kingsbury bearing.

Two other smaller water wheel generators are also installed in the mill and these too will be modernized in the future with vertical-shaft direct-connected generators in the same manner as described above.

Over a period of years, these three water-wheel units have supplied between 30 and 40 per cent of the required power for the mill.

Electric power from the new vertical generator is controlled at a Westinghouse switchboard, while that from the other two wheels is controlled at a General Electric switchboard.

Water Supply Improvements

Another step completed in the modernization program is the recent installation of a 20-in. pipe line from the canal into the mill and improvement of the existing water filters. All water entering the mill is filtered by a 4-section sand filter, Fig. 2, with a capacity of 3,000,000 gal a day. This filter was originally built by the company's engineers but has been improved and is now equipped with Cape May, N. J., filter sand.

To purify the sand and sterilize the water, a new Builders Providence chlorinator, Fig. 4, will inject suitable amounts of chlorine into the water in the new 20-in. pipe line ahead of the filters. This chlorinator is designed so that it can be easily arranged for automatic control at a later date, if it becomes desirable to put the entire water filtration system under full automatic control.

Still another modernization step just completed is the installation of a Fairbanks, Morse & Co. 1000-gpm fire pump driven by a Fairbanks, Morse motor.

Paper Machine Drives

Each of the two paper machines is driven by a Westinghouse 17-hp geared steam turbine, providing a speed range of 185 to 500 fpm on the paper machine. The turbine receives throttle steam at 165 psi, 50 F. superheat and exhausts at 30 psi to the paper machine drying rolls.

Steam for these turbines is generated by four boilers. Three of these are Dillon horizontal return tubular units, fired with coal by single-retort underfeed stokers. The fourth is a Bigelow water-tube unit fired with Bunker C fuel oil, which will provide steam for the mill during the warm summer months. In winter, two of the three coal-fired boilers must be operated. These four units produce a total of about 40,000 lb per hr of steam.

The company is giving serious consideration to installing a single new water-tube boiler to replace the three coal-fired boilers, retaining the oil-fired boiler for standby. Such a new boiler would be designed to burn fuel oil normally, but with provision for

(Continued on page 128)

Modern Power Distribution System

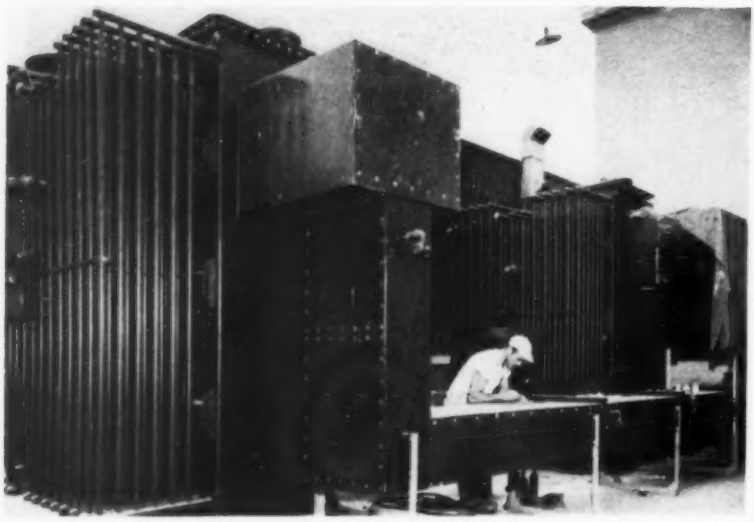


Fig. 1. Largest Benicia Arsenal substation, Station A, contains these two 3-phase, 3000-kva, 22.4/2.4 kv transformers. Note the bus duct carrying low-voltage power into the switchgear building (right)

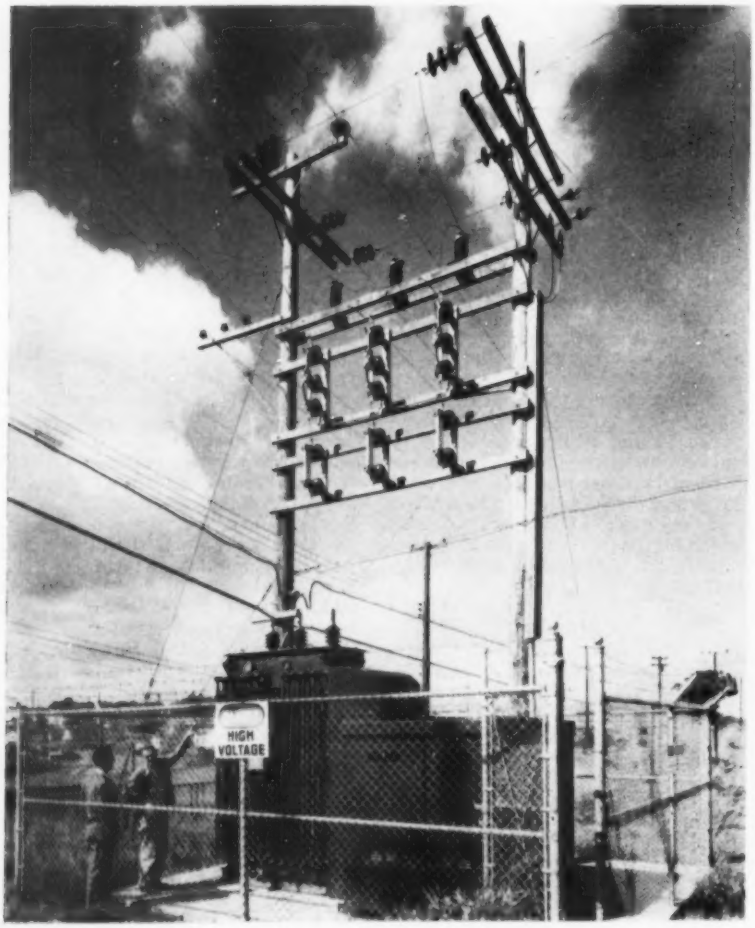


Fig. 2. Station B substation at Benicia Arsenal, 750 kva capacity, is shown here after its completion

BENICIA ARSENAL, located on San Francisco Bay at Benicia, Calif., recently installed what is believed to be one of the most modern large Army power distribution systems in the United States. The Arsenal is now one of the largest Army Ordnance Depots in the West.

To keep up with load requirements, the Arsenal went from an inadequate single-phase, open-conductor, low-voltage-type distribution (total load 3000 kva) to a modern, 3-phase, metal-enclosed system (total capacity 9750 kva). It consists of three substations, each located in the center of a predominant load area.

Largest substation (Station A) shown in Fig. 1, includes two 3-phase 3000-kva transformers which transform 22.4-kv incoming power to 2.4 kv. The high-voltage power to the transformers is carried underground by cable from a switching point on the edge of the Arsenal property. The low-voltage current from the transformers is carried by bus, through bus duct, into a building housing the metal-clad switchgear with type AM-5 magne-blast air circuit breakers rated 5000 v, 1200 amp, also buswork potential and current transformers for instrumentation, and control power transformers.

Since this station is actually an indoor-outdoor double-ended master unit substation, there is a tie-breaker in the center of the switchgear compartments that permits use of either one or both transformers. Limitations of space caused the transformers to be located outside.

The other substations (Stations B and C) are located at some distance from each other and approximately a mile and a half from Station A. Station B, Figs. 2 and 5, is rated at 750 kva, and receives its current

Fig. 3. Engineer inspects magne-blast breakers at one of the three new substations at Benicia Arsenal. Unit is on rollers to simplify maintenance

Now Serves Benicia Arsenal

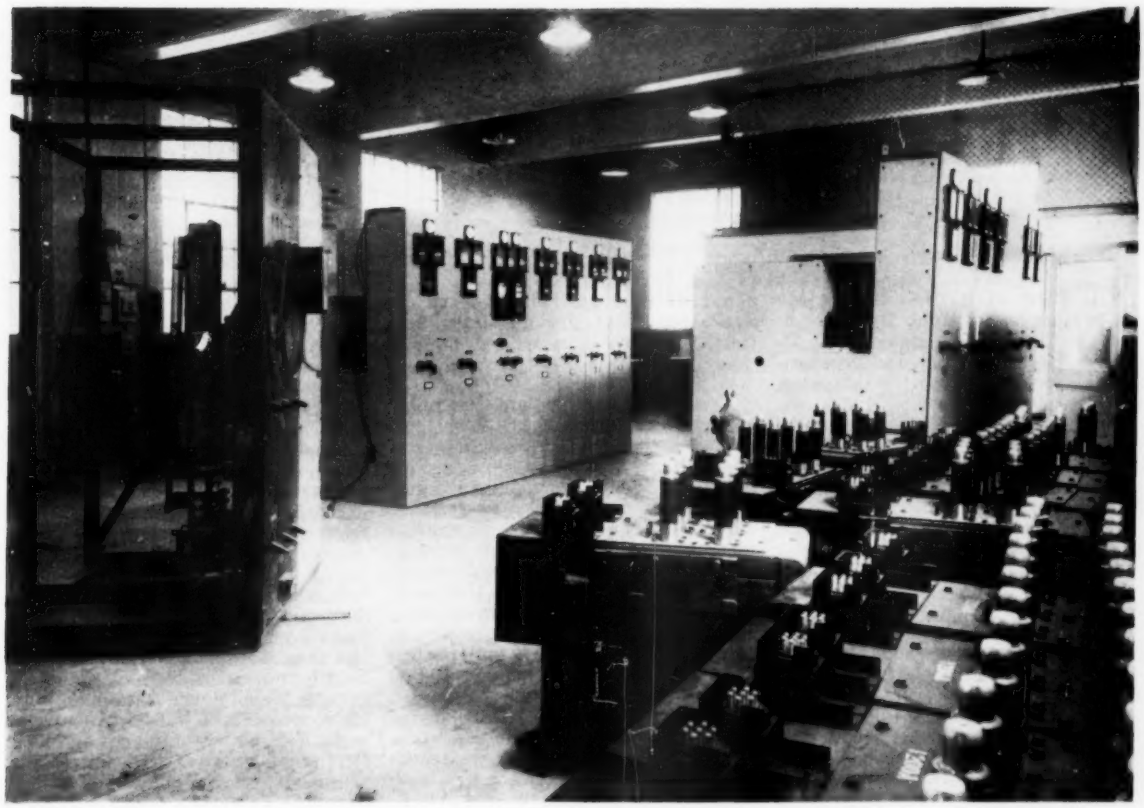


Fig. 4. New magne-blast air circuit breakers (right foreground) at Benicia before they were housed in metal-clad switchgear compartments (background). Old switchgear formerly used at Benicia is shown in left foreground. New equipment was housed in the same building, which required few modifications

direct from the switching point. It is a standard outdoor master unit substation. The station also contains a magne-blast air circuit breaker, metallic rectifiers, potential, current and control power transformers.

Station C is rated at 3000 kva, and also receives its current direct from the switching point at the edge of the Arsenal. It is basically the same package as Station B, contains same types of circuit breakers, rectifiers, transformers and other equipment.

These three substations and auxiliary equipment were supplied by General Electric Co. Contractor for the installation was Manning-Whitaker of San Francisco.

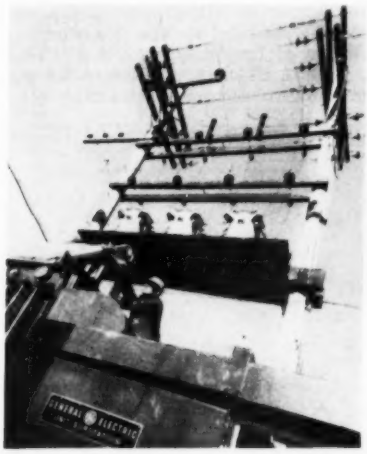


Fig. 5. Electrician removes crating from bushings of new transformer in 750-kva unit substation replacing overloaded transformers shown on platform

Fig. 6. Engineers of Benicia Arsenal and Manning-Whitaker prepare to withdraw recording meter from face of the 2.4 kv switchgear compartment

Fig. 7. Cable splicer completes power connection to one of the 3000-kva transformers at Station B. At left is 22.4 kv underground cable power input

How to Store, Handle and Heat Fuel Oil

Is your fuel oil system in good shape for cold weather? Here are latest methods of oil storage, handling, and heating

By PAUL R. UNGER

Mid-West Heat Service

FOR THE PURPOSE of this paper we will assume that No. 6 Bunker C oil is the liquid fuel. If lighter oils are burned, the problem is the same except that the temperatures required are less.

First consideration is the amount, location, and arrangement of oil storage. The amount of storage will vary, depending on the availability of bulk storage or refineries, and the possible delivery hazards as a result of weather, strikes, or other delays. If oil is the main or only fuel, I would recommend 15 days' storage under peak load conditions, with more if the plant is remote from bulk storage or subject to extreme snow and ice conditions. Roughly, the average installation will use 8⅓ gal per 1,000 lb. of steam. Thus a plant developing 50,000 lb of steam per hour, 24 hours per day, should have 50 x 8.33 x 24 x 15 or 150,000 gal of storage. This figure would be increased or decreased depending on the ease of delivery or the availability of other fuels.

Oil storage may be above ground, underground or inside the building.

Above Ground Tanks

Above ground storage must be located a varying distance from buildings, tracks or roads, depending on the size of the tank, and must be dyked so that in case of a rupture the entire contents will be held within the dyke. This dyke can be either earth or concrete. With capacities about 100,000 gal where space is available, above ground tanks are usually cheaper than underground.

Underground Tanks

Underground tanks are generally available in units up to 30,000 gal each, usually 10 ft 6 in. in diameter x 47 ft 6 in. long. We have on occasion installed 50,000 gal underground tanks 12 ft diameter by 60 ft long where delivery from a tank source was possible. Tanks must be anchored where there is a possible water condition that might float the tank when only partially full. On the average, a tank would have to be about 90 per cent full to hold it under total immersion without anchorage.

Tanks may be secured in one of four ways:

1. By placing a reinforced concrete slab under the tank with sole plates under the reinforcing rods and strapping the tanks to the sole plates. Sufficient concrete should be used so that the combined weight of the concrete, the tank, and the dirt directly above the concrete will be equal to the uplift of the empty tanks. A slab 12 in. thick, 1 ft longer and 1 ft wider than the total area of the tanks, with the tank top 3 ft below grade, will be sufficient.

2. By placing the tanks in the ground and pouring a slab over the top. This will require more concrete but less depth of excavation.

3. By the use of screw or expanding anchors.

4. By adequate drainage of any water at the tanks. It is usually wise to backfill with crushed limestone, lake sand, or other inert material.

Inside Tanks

In most parts of the country, tanks may be installed inside the building, often in the existing coal storage space. Fire insurance permits 50,000 gal maximum storage, 25,000 for each tank, in fireproof buildings, where tanks are surrounded by concrete or brick walls to a point 18 in. above the tank top and where all voids are filled with sand. Inside tanks should be set on 6 in. of gravel or on saddles to keep the bottom off the concrete floor. Inside tanks may be either round, shop or field fabricated or rectangular, tailored to fit the available space.

A combination of above or underground tanks with supplementary or day storage inside tanks is frequently used. We recently constructed a tank farm at the R. R. Donnelley plant in Chicago, consisting of six 30,000 gal underground tanks 600 ft from the boiler room, and constructed a 15,000 gal "H"-shaped day tank welded around the columns in the coal room.

Tank Farm Location

It is important that oil storage be located so that the suction lift to the fuel oil pump serving the burner be less than 15 in. of mercury. This is usually not a problem with above ground tanks, never a problem with inside storage, but is frequently a poser with underground storage. It is far more important to locate the tanks so that the oil burner pumps can draw from them easily than to worry about proximity to the track or truck unloading terminals. An unloading pump near the track or truck dock can easily pump oil to the oil storage tank.

It is preferable, but not essential, to locate the fuel oil pumping, heating and straining equipment in the boiler room. We are just now completing an oil burning installation in connection with the pulverized coal burning boilers at the Hawthorne Station of the Western Electric Co. in Cicero, Ill., in which the entire oil pumping, heating and straining sys-

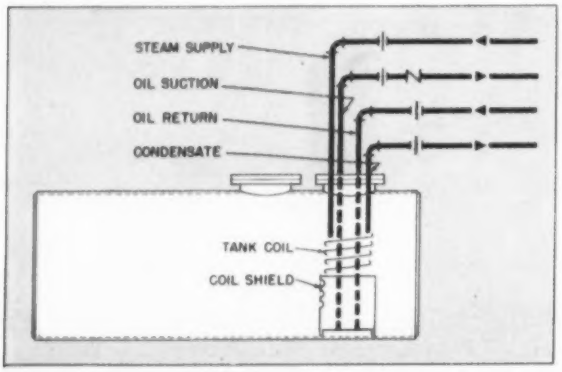


Fig. 1. Steam coil assembly for heating underground or inside storage tanks

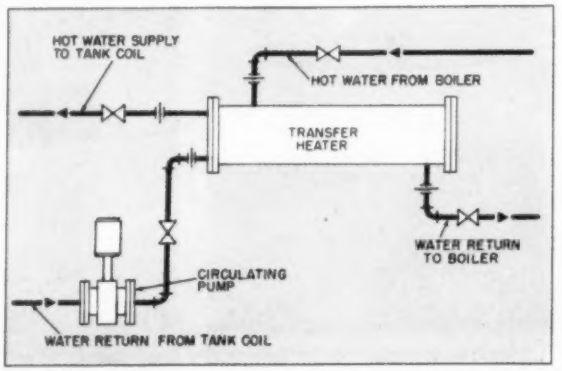


Fig. 2. Boiler heat is transferred to the oil for heating hot water in this heater

tem, handling 100 gpm of Bunker C fuel oil, is located under the band shell, near the oil tanks, but over 400 ft from the boilers.

This location was selected because the underground oil storage was in place when the decision was made to fire the three new 200,000 lb boilers with pulverized coal, oil or gas. The only building near the tanks was the band shell, which had a basement below in which, by careful planning, the fuel oil unloading and burner supply pumps, fuel oil heaters, strainers and interconnecting piping could be located.

The following equipment was installed: 1. — 150 gpm unloading pump to unload cars or trucks with four termini at the track; 2. — 50 gpm screw type oil pumps, one motor driven and one turbine driven; 3. — 15 gpm pump, motor driven; 4. — 50 gpm fuel oil heaters, each sized to heat Bunker C oil from 100 to 220 deg; duplex suction strainers ahead of unloading and supply pumps, and discharge strainers after the heaters.

We then ran a separate steam traced loop line to each boiler room underground, tying circulating and return lines together and returning to the storage tanks. The pressure drop in the entire line was held under 5 lb and the temperature drop under 5 deg F. The underground oil and tracer lines were separated from contact with each other but insulated together with Z-Crete.

Heating Oil Tanks

We should discuss at this point the best temperature to maintain in fuel oil storage. Fuel oil pumps can satisfactorily receive oil at viscosities above 10,000 S.S.U., but most economical results are obtained with a viscosity of 5,000 S.S.U. This corresponds to a temperature range of 90 F to 120 F, with most Bunker C oils. The old method of heating oil tanks was to cover the tank bottom with rows of horizontal steam piping, thus keeping the entire tank warm. This is wasteful. Heating the oil at the point of suction is sufficient.

There are today four acceptable methods of maintaining proper oil suction temperatures in oil tanks:

1. With a steam suction heater. These are generally of two types:

(a) For above ground tanks, a horizontal suction heater is bolted to a flange near the bottom of the tank, projecting inside the length of the heater, with a "U" tube or finned section in a pipe open at the end. The oil suction is drawn through the pipe around the steam tubing. A thermometer controller should be located at the heater outlet. Most heaters of this type are installed without provision for removal of the heater without first emptying the oil tank. It is not difficult to arrange a valve of the flapper type that can be closed from the top of the tank, so that the heater can be removed, or that will close itself in case of a fire in the tank or a break in the line. Provision also will have to be made for opening the valve from above after damage has been repaired. Arrangement is shown in Fig. 3.

(b) For underground or inside storage, the oil must be drawn through the tank top. A separate manhole should be installed in the tank top through which a spiral coil and suction and return lines should be installed in such a manner that the entire assembly can be removed from the tank if necessary (Fig. 1). By placing a metal shield around the coil and carrying the return line to near the bottom of the tank alongside the suction stub, the heat can be further localized and benefit received from the returning hot oil.

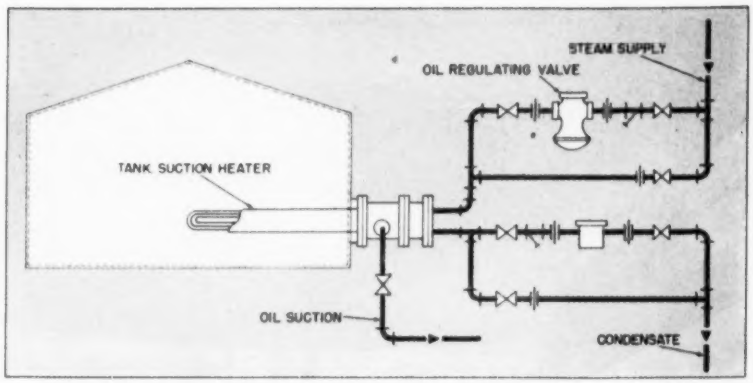


Fig. 3. Typical tank suction heater arrangement for steam-heated, above-ground fuel oil storage tanks

2. If it is difficult to lift the condensate from the coil, or if the boilers are hot water, circulating pumps should be provided to circulate hot water through the coils. In this case, it is advisable to provide a transfer heater using boiler water or steam to heat the hot water to the coils, as shown in Fig. 2. If there is a possibility of freeze-up, an anti-freeze solution can be used in the transfer heater and circulating system.

3. Many of our installations today are made without coils. We increase the size of the oil burner supply pumps and fuel oil heaters in the boiler room, and circulate sufficient excess hot oil to a hotwell in the oil tank to heat the oil suction line. This hotwell consists merely of an oil suction pipe concentric with a larger return pipe, both welded through an extra manhole in the tank, as shown in Fig. 4. With this system, an electric fuel oil heater is made a part of the pumping, heating and straining system, and the oil pump and electric heaters are started automatically to circulate warm oil throughout the piping and to the hotwell to maintain tank and line temperatures during periods when the burners are off and steam is not available and where the oil would become too viscous if not kept warm.

4. Figure 5 shows an all electric system where current is passed through the suction pipe and tank hotwell to maintain oil temperature.

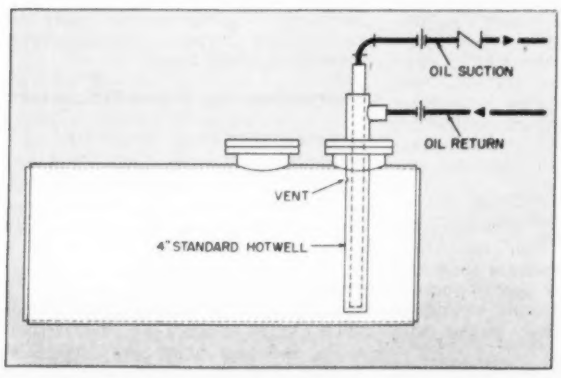


Fig. 4. This method uses no coils. Hot oil from boiler room heats tank oil

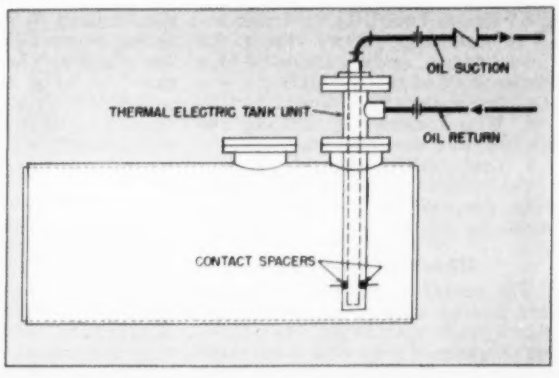
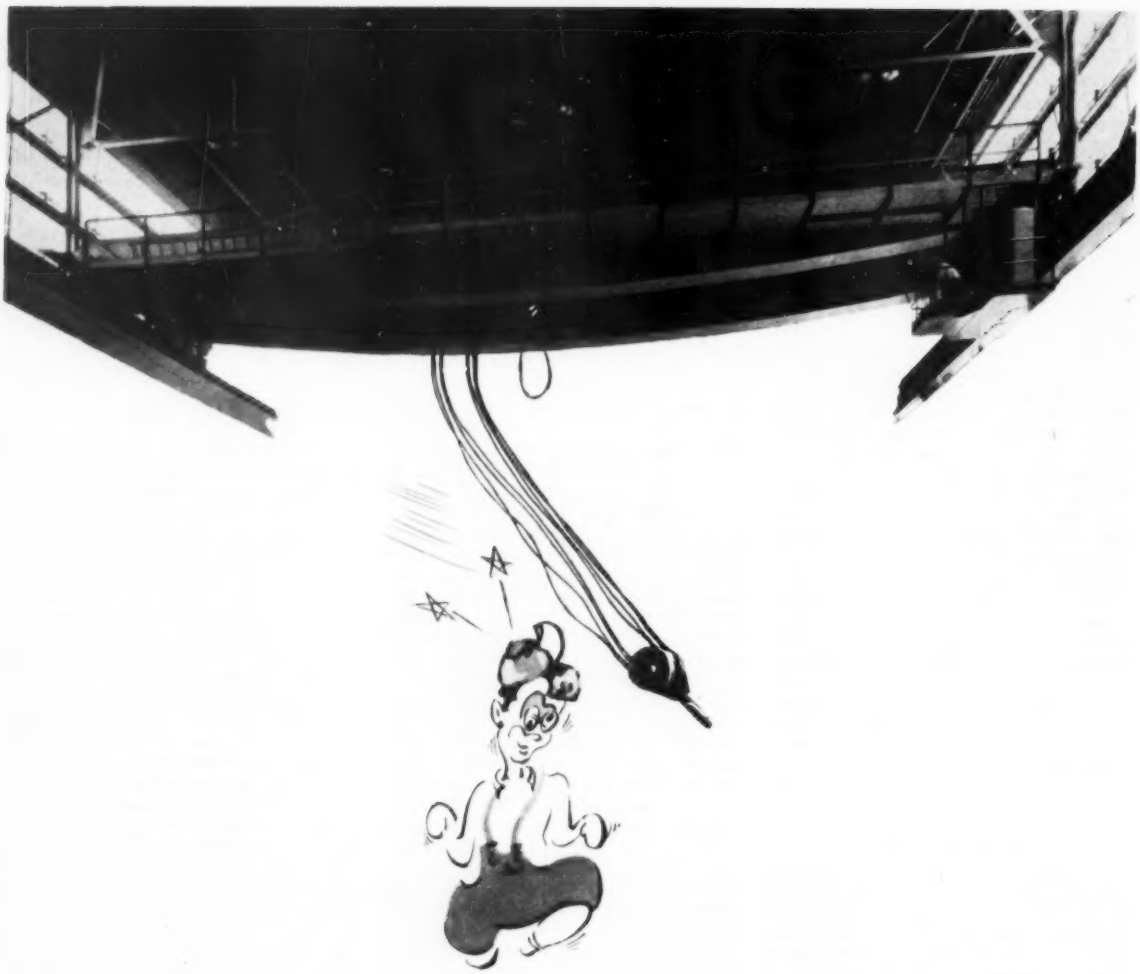


Fig. 5. Electric heating element in suction pipe and hotwell warms tank oil



Crane Accidents Can be Prevented

Incompetent operation, misunderstandings, or faulty equipment cause most of the country's crane accidents. All three causes can be eliminated by following these rules

SEVERAL THOUSAND crane accidents happen every year in the United States, and all are caused by one or more of these faults:

1. Incompetent operation.
2. Misunderstanding between the operator and men near the crane.
3. Faulty equipment.

This article describes how these three dangers can be reduced, and accidents prevented.

Operator Training

The supply of experienced operators seldom equals the demand, so plants must organize their own training programs if they wish to maintain a high standard of operation. Each candidate, at the end of his course, should have to pass a strict examination before being allowed to operate a crane. The plant should take care to have more trained men available than are needed for normal operation, to be sure of competent replacements when the regular operators are away on leave, sickness, etc.

Misunderstandings

Misunderstandings between the operator and men near the crane account for more accidents than any other cause. The only way to prevent them is to publish sound operating instructions, and then make sure they are obeyed.

Certain rules will depend on the particular duty of the crane, but the instructions given below apply to any general purpose industrial type travelling bridge crane.

Instructions for Crane Operators

Responsibility.

1. No one but an authorized operator is allowed to operate a crane.
2. Each operator is directly responsible for the safe operation of his crane.

Before operating crane.

1. Crane operators must inspect their cranes at the beginning of each shift, and test hoist limit switches, brakes, and other safety devices.
2. Check clevis bolts at the start

of each shift to make sure they are securely fastened.

3. Report any defects to Crane Supervisor immediately.

4. When there is any doubt about safety, the operator must not operate the crane or handle loads until safety has been assured.

5. During inspection, repair, cleaning and lubrication of the crane, the main switch in the cab should be locked in the "off" position.

Carrying load.

1. Operators must remain at the controls when making a lift or moving a load.

2. At no time is load to be left hanging from the crane unless there is an operator in the cab.

3. Never lower the block below the point where less than two full wraps of cable remain on the drum.

4. Never carry loads over workmen unless they are in a guarded area.

5. Sound warning bell when carrying loads, and give workmen time to move out of danger.

6. Take care the load does not swing; it may injure the floorman.

7. When lowering heavy loads, use intermediate speed steps on the controller.

8. When raising or lowering the load, see that it will clear adjacent stock piles.

9. Do not allow men to ride on load carried by crane, or on crane hooks.

10. Do not leave loads with any sling hooks hanging loose. If all sling hooks are not needed, remove extra hooks, or use a different sling.

11. All slings or cables must be removed from the crane hooks when they are not in use.

For a tear sheet of this article write to the Editor, or use one of the prepaid post cards you will find elsewhere in this issue. Just write CRANE SAFETY on the card and mail it to us.

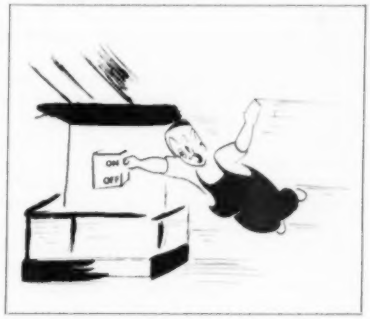
Operating control equipment.

1. If power fails, move controller to "off" position, so that crane will not start suddenly when power returns.

2. Always stop the controller at the "off" position for a moment instead of reversing instantly. The slight pause is necessary to give the braking mechanism time to work.

3. Before closing main switch, be sure controllers are in "off" positions, so that crane will not start unexpectedly.

4. If controls become faulty, open main switch and notify supervisor.



Crane maintenance.

1. The operator must keep the crane cab and platform clean.

2. Crane operators are not allowed to make repairs to their cranes.

3. Operators are forbidden to change fuses.

4. Whenever the crane is being lubricated, it must be moved to a position over an area where there are no workmen. If shop operations do not permit this procedure, the area directly below the crane must be roped off.

Picking up loads.

1. Always center the trolley over the load so that hoisting cables will be perpendicular to the floor. Avoid side pull on cable.

2. Always make sure the load is properly locked before hoisting. If the operator's vision is obstructed he must not hoist until signaled to do so by his floorman.

3. It is the joint responsibility of the operator and hitcher to ensure that all loose material, chips, and tools have been removed from the load before starting lift.

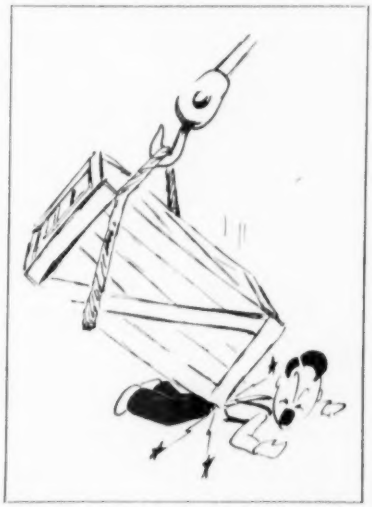
4. Make certain everyone is clear before load is moved.

5. Pick up load gradually to prevent sudden jerking of cables.

6. Use softener (felt or block of wood) to protect cable from sharp corners.

7. When ready to raise a heavy load, use the first step of the controller to take the slack out of the hoisting cable.

8. Be sure the hoist brake will hold a heavy load. If in doubt, test it after the load has been lifted a few inches.



Dragging.

1. Do not drag cables, ropes, or chains on floor.

2. Do not drag crane loads.

3. Never move railroad cars with crane.

Entering or leaving crane.

1. Crane operator must not carry anything in his hands when going up or down crane ladder.

2. If the operator leaves his crane for any reason, this procedure must be followed:

a. Raise the block to within 12 in. of hoist limit switch.

b. Spot crane at crane platform.

c. Place all controls in "off" position.

d. Pull main switch to "off" position.

Signals.

1. Never move a load unless a signal is clearly seen and understood.

2. Crane operators are to take signals from one person only during

lifts, but they must obey an emergency stop signal given by anyone. (Danger that the regular signal men cannot see may be present.)

3. The crane operator and hitcher form a team, and must cooperate perfectly for safety.

Hoist limit switch.

1. The block must not be raised closer than 12 in. to the hoist limit switch.

2. Hoist limit switches are safety devices, and must not be used to stop the hoist under normal operating conditions.

3. Never block or tamper with a limit switch in order to go higher.

Maintenance Inspections

Most plants carry out maintenance inspections, yet they still have accidents caused by faulty equipment. Some of the reasons why these inspections are ineffectual are:

1. They are not made regularly.

2. They are made by unqualified personnel.

3. They are made at the whim of the inspector, without a written schedule to ensure methodical procedure.

4. The results are often reported haphazardly.

5. Responsibility for action is not clearly defined, so work required by the inspection is often neglected.

Monthly inspections, using the type of form shown below, should be compulsory. The electrical inspection should be made by a qualified electrician; the mechanical, by a qualified mechanic. The reports should be sent to the Plant Maintenance Supervisor, who should be responsible for carrying out the required action.

For copies of this article write to the Editor, or use one of the prepaid post cards you will find elsewhere this issue. Just write CRANE SAFETY on the card and mail it to us.

Equipment

Safety devices.

Many cranes have extra limit switches, photo cells, and other devices added by the user to increase safety. Through poor maintenance, they often become inoperative, making the cranes more dangerous than if they had never been installed, because the operators then work with a false sense of security. For this reason, every safety device is a potential source of danger, and as few as possible should be added to those installed by the crane manufacturer. If an operator is unable to manage his crane properly, the solution is to replace him, not to load the crane with devices to serve as a substitute for alert and competent operation.

Maintenance or Repair Work

When maintenance or repair work is to be performed near, on, or from a crane, this procedure must be followed:

1. The man in charge of the work will first notify the general foreman of the department in which the work is to be done, giving him full information about the location, nature, and extent of the work.

2. The man in charge of the work will then give the same information to the crane operator.

3. The operator will then spot the crane at a convenient location.

4. The crane operator must lock main switch in "off" position.

5. If any crane movements are required during the course of work, the man in charge of the work shall assume complete charge of the crane movement. The crane operator during this time shall not take orders for crane movement from anyone else.

6. The crane operator shall keep the crane switch locked in the "off" position while work is in progress, except when ordered to move the crane by the workman in charge. When each movement of the crane has been completed as directed by the workman in charge, the main switch must again be locked "off".

7. When the work is finished, the man in charge, together with the crane operator, shall inspect the crane to make sure it is in proper condition for operation and that no loose parts, materials, or tools have been left on it.

8. When the inspection is finished, and all men connected with the work have left the crane, the workman in charge shall inform the crane operator that work has been finished and the crane is ready for operation.

9. The workman in charge shall then inform the general foreman that the work has been done.

Typical form for reporting details of mechanical inspection every month

To: Plant Maintenance Supervisor

Crane Inspection Report

Date _____ Machine _____ No. _____

Mechanical	OK	REMARKS
Hoist block (Chipped wheels)		
Hoist cable (Broken strands)		
Hoist drum (Rough edges)		
Brakes (Shoe wear)		
Bridge alignment (Screeching wheels)		
Runway rails (Broken, cracked, or chipped)		
Trolley rails (Broken, cracked, or chipped)		
Bridge wheels (Broken, cracked, or chipped)		
Trolley wheels (Broken, cracked, or chipped)		
Gears (Grinding or squealing)		
Safety guards and footwalks		
End stops on main runway		
Bumpy riding (worn wheels)		
Lubrication (Cups empty, dirty, or overflowing)		
Couplings and bearings (Loose, worn)		
Any other condition which interferes with safe operation of crane		

Signed _____

Typical form for reporting details of electrical inspection every month

To: Plant Maintenance Supervisor

Crane Inspection Report

Date _____ Machine _____ No. _____

Electrical	OK	REMARKS
Hoist motor (Dirty, loose connections)		
Trolley motor (" " ")		
Bridge motor (" " ")		
Hoist controller (Dirty contacts, not enough finger pressure)		
Bridge controller (" " " " " ")		
Hoist limit switch		
Grids (Loose or dirty)		
Fuses (Clips loose or dirty)		
Warning bell		
Electric brakes		
Main trolley wires		
Bridge trolley wires		
Main trolley shoes		
Bridge trolley shoes		
Signal lights		
Safety switches		
Knife switches		
Items not listed		

Signed _____

The Banki Inward-Flow Hydraulic Turbine

Dr. Banki's inward-flow hydraulic turbine, forty years from being new, advances simplicity and economy of fabrication, erection, maintenance, and operation as its claims to fame. Long used and favored abroad, it is seldom seen in the U.S.

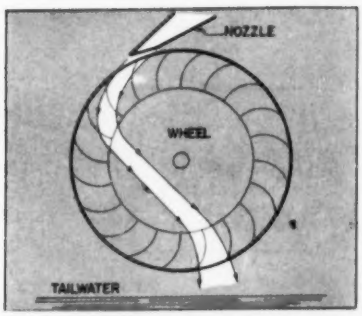


Fig. 1. Nozzle and wheel arrangement of the Banki unit built and tested by students at Oregon State

FOR MANY YEARS there has been a country cousin of the hydraulic turbine family which possesses characteristics most interesting to power engineers. Its lack of recognition and development, puzzling to many, is another example of the eddies forming on the fringes of technical progress. The proper name for this turbine is "The Banki Water Turbine"; descriptively, it is a horizontal, atmospheric, radial flow wheel which derives its power from the kinetic energy of an inward water jet.

Dr. Donat Banki developed the idea and the turbine nearly 40 years ago while a professor of engineering at the Hungarian Technical University in Budapest. Since that time, the Europeans have made good and frequent use of it. With the exception of many small units presently installed in the Pacific Northwest, we have not.

The Banki turbine resembles a squirrel cage blower in appearance, for it consists of horizontal blades fixed between circular end plates to which the shaft is attached (see Fig. 3). These blades are curved to direct water inward through the open cylindrical space between the blades and outward to the tail-water through the blades at another point. The nozzle projects a rectangular (cross-section) stream of water against the full width of the wheel at 16 deg.

As the turbine exists at this time, it is a low-head unit which exacts maximum efficiency at a nearly constant speed for all gate openings at constant head. Its characteristic specific speed (n_s) fills the gap between the Pelton wheel n_s range (3 to 7.5) and the Francis wheel n_s range (12 to 120), its range being 2 to 16. Maximum efficiency for the impulse wheel occurs at $n_s = 4.5$, for the Francis wheel at $n_s = 50$, and for the Banki wheel at $n_s = 14$ — all figures being approximate.

Banki's original turbine yielded a best efficiency of about 85 per cent. A more recent model of only 3 hp built to Banki's specifications by Professors Mockmore and Merryfield at Oregon State College yielded a maximum efficiency of 68 per cent at $n = 270$ rpm and $n_s = 14$. The lower efficiency can be attributed to less exact machining, the low hp rating of the turbine, loss of water before extraction of power, and lack of experimental changes before conducting the tests.

Results of the Oregon State tests led the professors to the following significant conclusions: (1) This turbine can be operated efficiently on a wider range of gate openings than most turbines; (2) Bhp varies almost directly with the 3/2 power of the head; (3) Maximum efficiency occurs at nearly constant speed for all gate openings at constant head; (4) The effective width of the wheel can be changed at will without changing the angle of attack (angle at which the jet enters the wheel).

In addition to these good reasons, the Banki turbine (or a unit adapted from its principle) holds promise for the following reasons: (1) It requires no thrust bearings; (2) It can be coupled to horizontal generators; (3) It can be coupled to a second turbine unit for increased power; (4) It is simple and inexpensive to manufacture; (5) Erection and maintenance are extremely simple; (6) It is adaptable to standardization of parts (another factor governing expense); (7) Installations of multiple units coupled together could give high efficiency at widely varying loads; (8) Governing is accomplished by varying the thickness of the jet without varying the width, thereby maintaining load on the full width of the blades; (9) Lubrication is extremely simple.

(Continued on page 158)

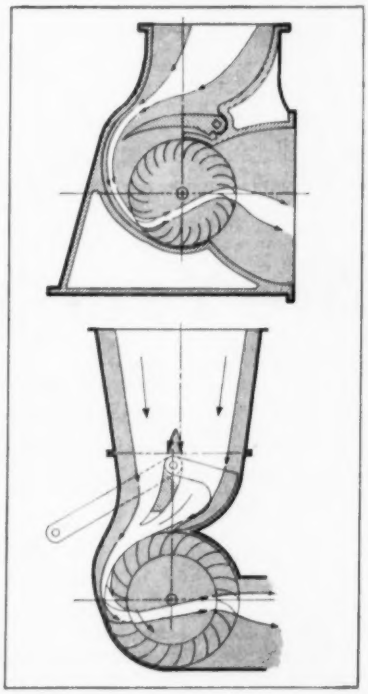


Fig. 2. Two patented German nozzle arrangements

Fig. 3. Close-up view of the Banki wheel built at Oregon State. Wheel developed 2.75 hp at 16 ft head

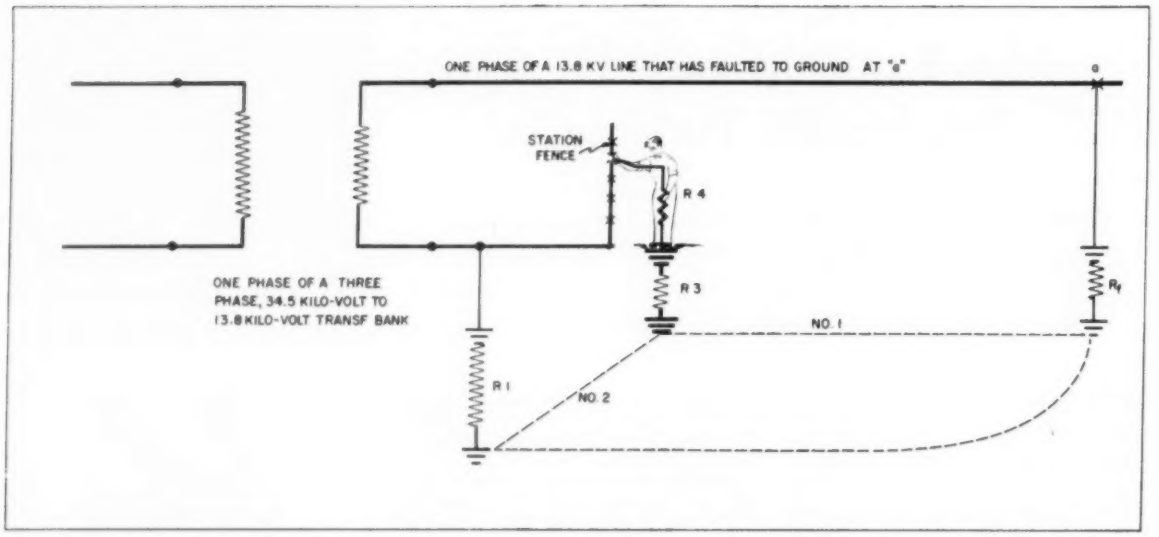

ONE PHASE OF A 13.8 KV LINE THAT HAS FAULTED TO GROUND AT "a"
a
STATION FENCE
R 4
R 3
R_F
ONE PHASE OF A THREE PHASE, 34.5 KILO-VOLT TO 13.8 KILO-VOLT TRANSF BANK
NO. 1
R 1
NO. 2

Fig. 1. Diagram representing one phase of a three-phase substation and showing how a man can be killed by touching the grounded fence during a fault

Are Your Station Grounds Safe?

Many station grounding systems, good enough for equipment protection, will not prevent men getting killed if they touch the equipment during a fault. Here's why, and what you can do

By ROBERT S. HORN
Electrical Engineer, U. S. Navy Department, Guam

YEARS OF EXPERIENCE in the electric utility field indicate that while great importance is generally attached to proper power station and substation grounding, certain details of the over-all layout of a station grounding system are often not fuily appreciated even by those responsible for station design. This is borne out by the inadequate design of the grounding systems at some existing stations.

When a station has a good ground-lead network, a multiplicity of good grounding electrodes (or grounding rods) and an over-all low value of ground resistance, and furthermore has every element in it grounded that should be grounded, it is often said to be well grounded. Such a station, however, may not be adequately grounded as far as the safety of station personnel is concerned. It is this kind of station-grounding deficiency we are going to discuss.

Figure 2 represents the plan view of a substation enclosed by a metal fence. The station contains a delta-primary wye-secondary connected transformer, other equipment having been omitted for simplicity. It also contains a good grounding network and four grounding rods as indicated in Fig. 1. The secondary neutral is grounded as shown in Figs. 1 and 2.

Figure 1 shows how dangerous a station fence may become during the time ground-fault current flows as the result of a phase-to-ground fault (outside the station) on a line that is fed by a station transformer (or transformer bank) that has its secondary neutral grounded.

Transformer winding shown in Fig. 1 represents one phase of a conventional 3-phase transformer or transformer bank. The other two phases of our substation have been omitted for clarity. The resistance R_1 represents the earth resistance of the station grounding system. There is negligible resistance between the fence, which is set in concrete, and the ground. Very often this will not be true, but as this particular resistance does not affect the problem we are discussing, it is simpler to omit it here.

Current Flows During Fault

Resistances R_2 and R_4 are those associated with a man standing adjacent to and in contact with the station fence. In this case R_3 represents the man's foot-to-earth-contact resistance while R_4 represents the resistance of his body which is connected to the fence and earth.

We may now proceed with our analysis of conditions during a phase-to-ground fault period. The resistance R_F represents the ground resistance at a phase-to-ground fault point somewhere outside the station fence. As may be seen, the circuit is now complete for the flow of ground-fault current.

The main flow of current in the earth will of course be between R_F and R_1. This current path is indicated by a curved dashed line. A relatively small current will also flow between R_F and R_3 as indicated by the dashed line No. 1.

Another current flows through R_1 as indicated by the dashed line No. 2. This current is caused by the potential drop across the station grounding resistance R_1. When R_1 is carrying a heavy ground-fault current the potential drop across it may easily reach a value of the order of 1000 volts or more. This potential drop across R_1 is impressed across the shunt circuit, consisting of R_3 and R_4 in series, as this shunt circuit is in parallel with R_1, thus subjecting R_4 to a lethal voltage. As may be readily seen, this is one reason why

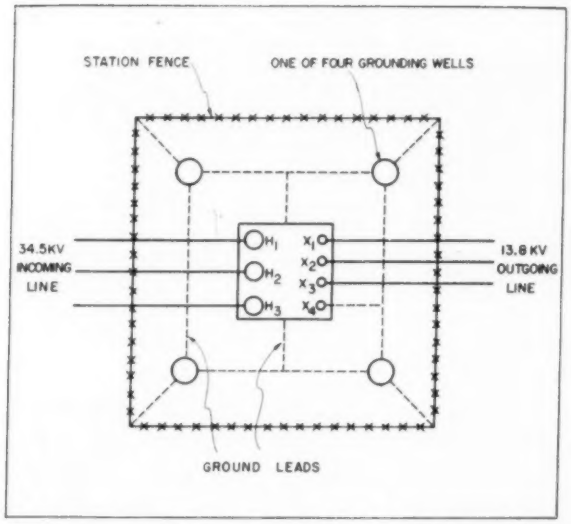


Fig. 2. Diagram of substation with grounding rods and enclosing metal fence

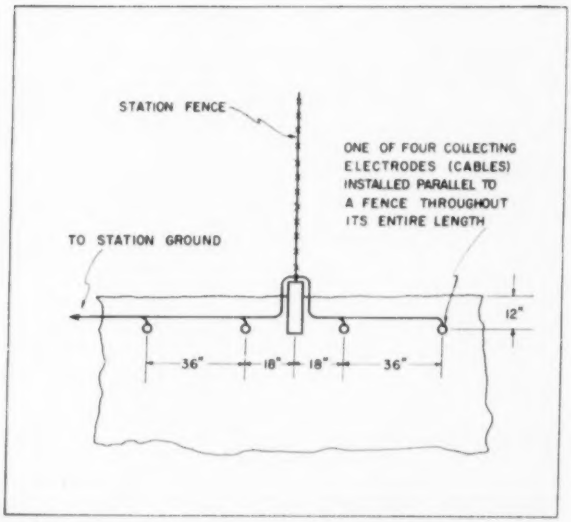


Fig. 3. Four ground conductors to prevent high fence potential during a fault

a fence and other structures at a station can be dangerous if the resistance of the grounding system is above a certain value. This value depends on the maximum fault current that can flow with a close-in low-resistance phase-to-ground fault.

Making Grounds Safe

One very good way that has been used to make the ground safe to stand on while in contact with various metal structures at a substation, such as its enclosing fence and any metal work within the enclosure, is to lay a conducting mat below the ground surface over the entire area covered by the station plus an area outside the station fence corresponding to a border of at least 4 ft. Such a mat will act as a collecting electrode. It will collect practically all of the current that would otherwise reach R_3 in Fig. 2, or in other words the feet of a person standing in the area and in contact with the fence or other structure that is connected to the station grounding system.

Buried Copper Cable

There is nothing new about the use of copper mats, but they are expensive to lay after a station has been built. There is an alternative, however, that is quite effective. It consists of laying bare copper or other suitable cables about 1 to 2 ft below the surface in such a pattern that they will collect all ground current that might otherwise reach a person standing on the earth inside or outside a station while in contact with any metal structure that is connected to the station-grounding system.

For example, ground conductors installed as shown in Fig. 3 which run parallel to a station fence throughout its perimeter would, in the case of most small substations, make the fence safe for a painter who may spend many hours in contact with it and the earth, during which time a phase-to-ground fault could occur which otherwise would be fatal to him. What has been said about the danger of a station fence also applies to any structure inside or outside a substation fence that is connected to the station grounding system, with which a person may come in contact while standing on earth not protected by a ground mat.

Dangerous Water Piping

Where a station such as an outlying substation receives water from a local water system, the piping outside the station may be as dangerous as the station fence cited above. This danger may be eliminated by installing an insulating link between the water system and the piping in the station area.

Some utility companies install this link at the station property line. The type of insulating link required for this purpose should, of course, provide much greater insulation than that provided by insulating links that are used to reduce electrolytic action on pipe lines. In the one case we may be dealing with a ground-return circuit with a sum total voltage drop which may be as much as 1000 to 2000 volts or more, while in the other, the potential drop across the link is seldom greater than a few volts.

That a water pipe, used as or connected to a station grounding system, can become electrically hot with respect to earth 3 or 4 ft from the pipe, is simply a matter of IR drop in the earth adjacent to the pipe. (See Fig. 4.) That it is not a rare occurrence for a water pipe to become dangerous appears to be borne out by the number of plumbers and others who receive severe or fatal electrical shock annually in the United States while working in contact with a water pipe and the earth. Consequently, at all sources of electrical power such as power plants, substations and large transformer banks, precautions should be taken to prevent water pipes from becoming electrically hot with respect to the earth in the immediate vicinity of the pipes during fault periods or lightning discharges through station lines and equipment.

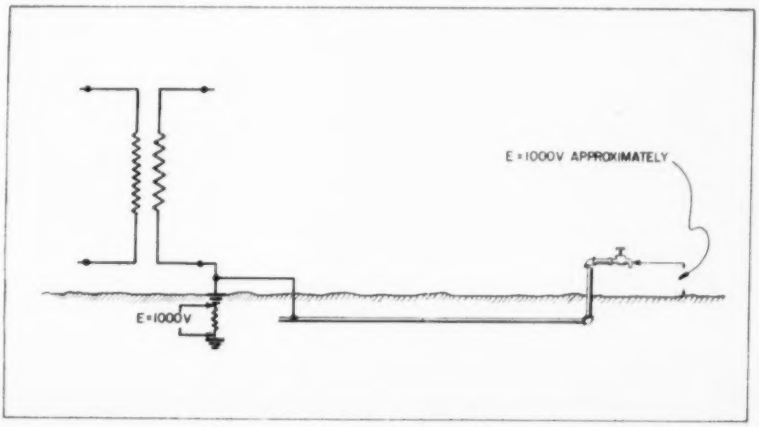


Fig. 4. A water pipe connected to a substation ground can be dangerous during a phase to ground fault

TV—New Tool for Power Engineers

Spectacular success of home television has diverted attention from the steady growth of industrial TV; yet this new tool already has been widely and successfully used, and experts predict a great future for it

By
HENRY DE SOTO
Consulting Engineer

THE PHENOMENAL RISE of television for home entertainment has obscured the less spectacular but steady growth of industrial and scientific TV. Industrial television already has been widely applied in industry, and it is proving such a flexible and efficient tool that new uses for it are being found continuously. Here are just a few of its applications. In steel mills it enables the operator to look inside the blast furnace, previously impossible due to the intense heat; it is used to help industrial plant security, where one guard can watch widely scattered points at the same time; it is used in atomic energy installations where scientists, working with dangerously radioactive materials, remain behind protective barriers and use TV as remote eyes to see the work. In the power plant it allows the operator to remain in his control room and observe equipment normally invisible or difficult to see. For example, in Fig. 3 the operator, without moving from his control board, can see the inside of the furnace, smoke coming out of the stacks, and the boiler-water-level gage.

Being able to see inside the combustion chamber is a great help to the operator in maintaining good combustion. Until recently it was very difficult to obtain a view of the inside of a furnace, and the excellent series of photographs of boiler combustion taken as recently as 1951 by Otto De Lorenzi, vice-president of Combustion Engineering, Inc., were obtained only after a great deal of work and with the use of a specially built camera.

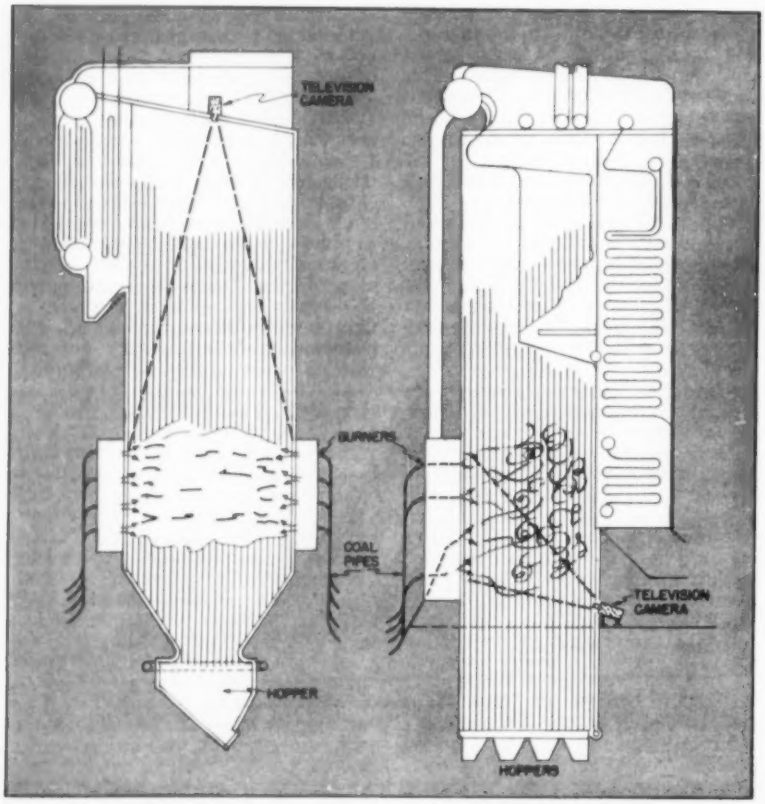


Fig. 1. Diagrams showing typical television camera locations or telecasting boiler combustion chamber

Closed Circuit TV

Industrial TV is much simpler than the standard home-type. It consists of a camera, a power supply, and a monitor or viewer. Unlike the home-type sets, which receive radiated signals, the industrial TV reviewer receives its signals along a coaxial cable between camera and viewer. This is known as a closed circuit system and has several advantages. There is no need for an F.C.C. license to install or operate a closed circuit system; the equipment is smaller and cheaper than the ordinary type; for example, a closed circuit set has only 17 to 20 tubes compared with the hundreds required in commercial TV to transmit a picture from the studio to a receiver; better color or black and white images can be sent with this system, and it can be operated continuously without attention or failure.

Industrial TV is used most frequently in power plants to observe conditions inside the combustion chamber, to observe the quality of smoke emission from the stacks, and to give direct observation of boiler-water-level gages.

Combustion Observation

Televiewing the inside of the combustion chamber not only lets the operator see if his fuel is burning properly, but also shows him if all the ignition torches light, if the fuel is ignited properly, and, when the furnace is in operation, if there is any trouble due to fuel stoppage.

Figure 1 shows two typical locations for the TV camera for viewing the inside of the combustion chamber. Keeping the lens cool is difficult. In some installations it is protected by a watercooled window; in others by air cooling, using air at a pressure of about 1 psi. In the Long Island

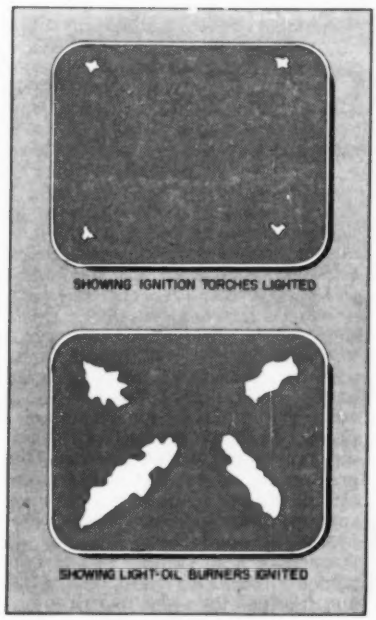


Fig. 2. Two typical combustion chamber conditions

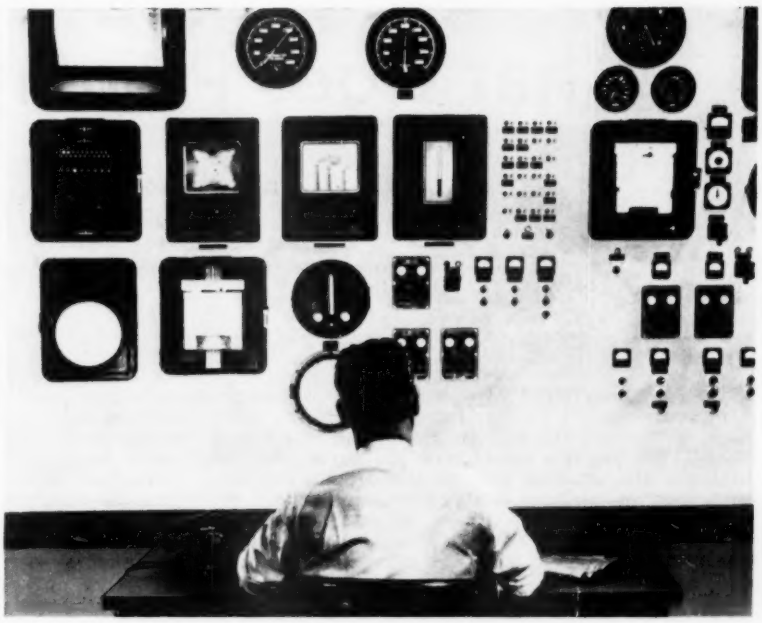


Fig. 3. TV shows the operator his combustion conditions, smoke emission, and boiler-water-level gage

Lighting Co.'s Port Jefferson plant, which served as a proving ground for much of this development, the lens was protected by a watercooled window with the further protection of a compressed air chamber.

Watching Water Level

State codes are very strict when it comes to boiler-water-level gages, and up to now most of them have insisted on a direct line of sight between the operator and the gage glass. Where the operator is too far away from the glass to see it clearly, or where there are obstructions between him and the glass, one or more mirrors are used to reflect the image of the gage to where he can see it. TV is a convenient and less cumbersome method of viewing these gage glasses. The method has the advantage of failing to safety, since it will either show the correct water level or nothing at all, but it cannot give an incorrect reading. Present indications are that most state codes that so far have insisted on a direct line of sight will eventually accept closed circuit TV as a legitimate method of reading water-level gages.

To employ a man as a smoke watcher is both expensive and inefficient. By televising the stacks and showing them on the control room screen the operator can see at once when his combustion is poor, and if in addition he has a picture of the furnace, he has an even better chance of curing the trouble.

For data on which this article is based the author is indebted to Diamond Power Specialty Corp., Radio Corporation of America, and Allen B. DuMont Laboratories Inc.

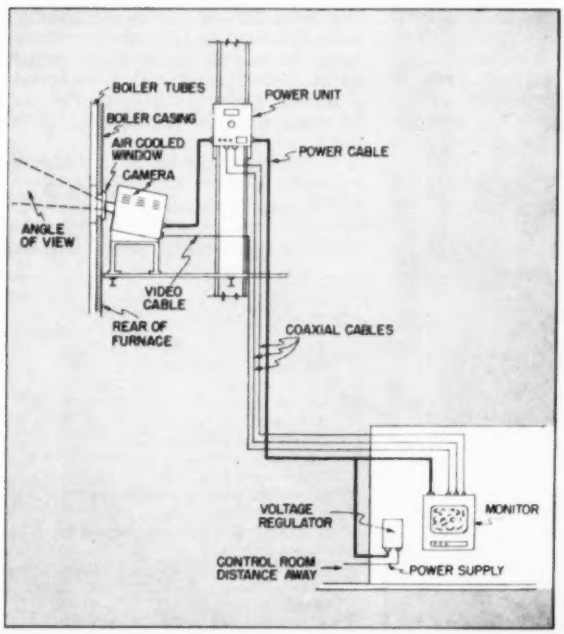


Fig. 4. Diagram shows typical closed circuit industrial television hook-up

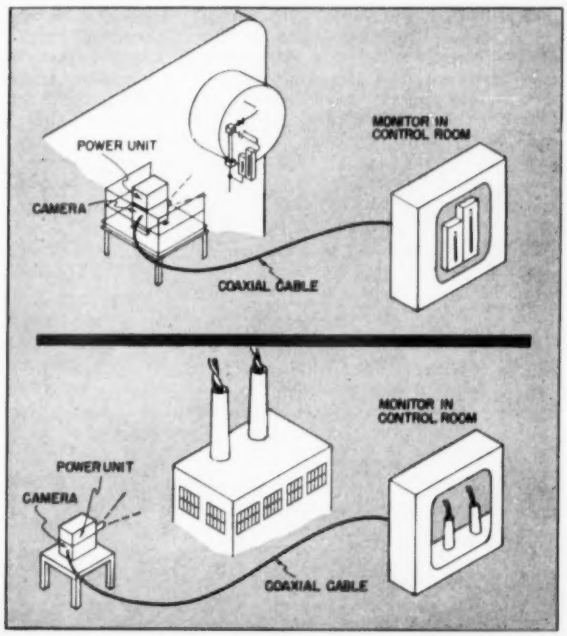


Fig. 5. Industrial TV hook-up for (top) water column and (bottom) stack smoke

What Does Painting Cost?

By L. G. JONES

Author explains how to estimate your paint job properly and how to be sure of good value for your money

COST IS DEFINED by the dictionary as ". . . the amount paid, given, or charged for anything". The cost of a can of paint is probably the smallest part of the total cost of utilizing that paint. Total cost of utilization can be broken down into the following components: 1. Price of the paint in the can; 2. Cost of this paint in terms of units of surface covered; 3. Cost of labor in applying the paint to the surface; 4. Ultimate cost in terms of time and life.

Price Of Paint in the Can

While the cheapest paint nearly always contains the cheapest ingredients, it does not follow that the highest-priced paints contain the finest ingredients. For general power plant work, especially maintenance, paints at both ends of the competitive price range might be dismissed when selecting the best paint for a particular job.

This first step is particularly safe if the vendors or producers of these "end of the list" paints are not well established as reputable suppliers. In fact, the second step would be to determine the dependability of the suppliers of the remaining competitive makes. Generally speaking, unless one is an expert it is best to stick to the "brand names".

Final step in selection depends upon laboratory findings. Paint salesmen are not always as well grounded in the chemistry and technical qualities of their products as they should be. Some paint producers put their full formulas on the cans so that the buyer may have some facts upon which to relate price to values. Frequently the literature supplied gives enough data to form a judgment. However, unless the paint has an established standing with the firm, the laboratory or paint supervisor must put the paint through enough tests to decide whether the paint is worth the price.

Number of sq ft that will be covered by a gallon of paint forms the basis of cost calculations. The spreading rate listed for a proper paint should be studied carefully. If the paint has an excessive spreading rate per gallon, the coating may be too thin to provide adequate protection or have enough hiding power to give a good appearance with the number of coats planned for the job.

Paint film must have the proper thickness for the type of paint and surface specified, in order to get expected service, finish and life expectancy. These three factors all depend upon the film thickness and spreading rate. Rough, porous surfaces reduce the spreading rate, since the actual surface area is greater than the measured square footage. Table 3 gives an example of the roughness and porosity of paint coverage.[1]

Thinness of the paint affects its coverage in two ways: first, a thin paint leaves a thin film because it wets the surface quicker than a heavy body paint. Second, the brushing flows and levels faster so that greater spreading speed broadens the coverage. This is also true of spraying, rolling, flocoating and other means of application. The painter frequently adds thinner to heavier paints in order to speed up the job and increase the spreading rate.

Paint Viscosity

Viscosity or body of a given type or grade of paint can be determined simply by means of a weighted hydrometer floated in the can, or by weighing the full fresh unopened can. Given types of paint in similar cans should have the same weight or one should seek the reason for any appreciable variation. Table 2 gives the weights of some common paints, thinners, etc.

In the paint shop, funnel drop or other simple reproducible tests can be improvised to determine flow or viscosity characteristics at room temperatures. It must be borne in mind that temperature greatly affects viscosity. All tests, to be comparable, must be done at the same temperature. It might be well to adjust paint viscosity for the actual temperature encountered on the job by controlling the amount of thinner used.

If the same thickness or viscosity

[1] Bulletin 89, Carbolineum Wood Preserving Co.

Table 1. Painting capabilities of an average painter, using various methods and paint spreading rates

	Method of application		
	Brush	Roller	Spray
Square feet of surface area a painter can cover:			
In an 8-hour working day *	1,500	2,400	5,000
In one average working hour	190	300	625
Number of gals per painter per 8-hour working day at the following spreading rates:**			
200 sq ft per gal	8	12	26
400 sq ft per gal	4	6	13
600 sq ft per gal	2.7	4	8.5
Number of hours per painter per gal of paint at following spreading rates:**			
200 sq ft per gal	1.0	0.7	0.32
400 sq ft per gal	2.1	1.5	0.65
600 sq ft per gal	3.3	2.2	1.00

* Total time 9 hours with 8 net working hours per normal day.
** See spreading rate tables of paints, Table 2.

Table 2. Weights of common paints and varnishes

Type of Paint, Thinner, etc.	Weight of One Gallon Including Can, lbs
Red lead — oxide ground-prime coating	17
Exterior house paints	15
Traffic and floor coatings	14
Chromate inhibitive ground-primers	12
Transformer paints	12
Latex water emulsion finishes	12
Lacquers, synthetic enamels	11
Synthetic enamel thinners	10
Aluminum paints	9
Turpentine	8.25
Clear varnishes	8
Lacquer thinners	8
Alcohol, grain	7.5

were maintained when thinner is added to cans of paint that are retained for repeated use, the same quality of film and character of work could be maintained. Records in a stock book or on labels could specify these viscosity figures for future reproduction.

Max Kronstein[2] did some interesting work on film thicknesses, measured by a magnagage, and their resistance to salt fog corrosion, that points out the hazards of too thin a spread on metal surfaces. Some of his results are shown in Table 7. Kronstein traced the film profile by means of a Brush surface analyzer which draws a chart of rise and fall of the surface film after various periods of exposure that break down the film irregularly. He recommends that the coating thickness be three times the profile depth to resist moisture penetration. He favors this form of panel testing with different film thicknesses in order to determine the best thicknesses for greatest surface protection with various paints.

Spreading Rate

There is no mathematical ratio between viscosity, weight, and spreading rate, but empirical values can easily be set up in a shop for the paint's particular uses that would help in estimating job costs, paint and labor requirements, and gallons of paint to be bought for each job. Table 4 lists the spreading and drying rates of the various paints at normal room and weather temperatures. These rates are based upon brush application of the paint.

Allowance must be made for the age, porosity, darkness, and roughness of the surface to be painted with one coat. Second coats always increase the spreading rate to the highest figure because the first coat carries the burden of the job. This is important when estimating paint and labor for large projects.

For metal protection, the ratio of spreading rate to the coating life

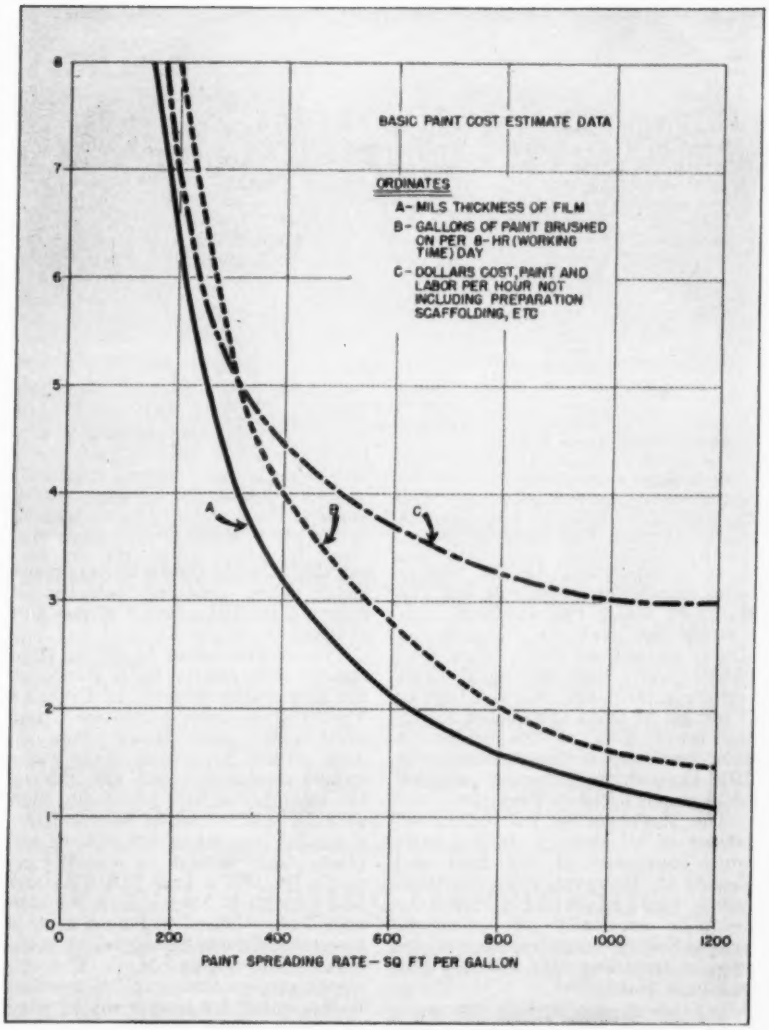


Fig 1. Chart for estimating labor and material costs and paint quantities for various spreading rates

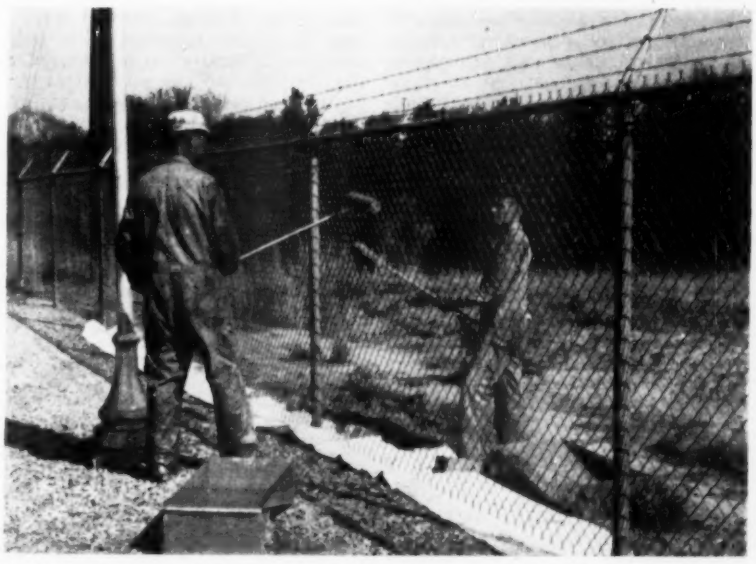


Fig. 2. Fence painting with 13 in. soft rollers. Vertical motion used for fabric; horizontal for rails

[2] New York University, Chemical Engineering, June 1952.

Tables 3 & 4 show effect of roughness on coverage and effect of spreading rate on coating life

	Coverage, one coat, sq ft per gal	
First coat	Brushing	Spraying
Dressed lumber	200	150
Rough lumber	100	75
Shingle roof	100	75
Second coat		
Dressed lumber	600	450
Rough lumber	300	225
Shingle roof	300	225

Table 4.
Effect of spreading rate on coating life

After seven years exposure	Number of panels rated excellent and good out of 18 panels evaluated		
Quality	Spreading rates, sq ft per gal of paint		
	600	900	1200
Excellent . . .	6	3	3
Good	6	5	1

Table 5. Lists spreading and drying rates for various paints at normal room and weather temperatures

Type of paint	Use	Properties	Spreading rate sq ft per gal	Drying time, hours TO TOUCH	Drying time, hours DRY
Red lead	Ground coat	Metal primer	400 to 500	2 to 5	12 to 24
House	Outside	Wood, etc.	450 to 550	6	24
Traffic	Outside roads	Concrete lines	400	45 minutes for traffic	
Chromate	Ground coat	Metal primer	400 to 500	2 to 4	24
Transformer	Outside	Metal finish	400	2	4
Latex water	Inside walls	Water base	400 to 500	1	8
Lacquer	Inside materials	High gloss	400 to 500	2	4
Synthetics	Enamels	High gloss	400 to 500	2	4
Floor, deck	Enamels	High gloss	350 to 450	2	over night
Aluminum	Outside brick, concrete, etc.		300 to 500	1	24
Aluminum	Outside repainted surfaces		500 to 600	1	24
Aluminum	General	Clean metals	600 to 700	1	24
Varnish	General	Clear high gloss	450 to 600	2	4
Varnish stain	General	Colored	450 to 600	2	4
Whites	General	With hiding power	450	3	24
Stains	Shingle	Penetration	100 to 200	1	5
Masonry, water or oil base	Porous brick, stucco, plaster		200 to 400	4	24
Primer-sealers or oil base	Porous wood, brick, plaster		200 to 400	4	24

is very important. ASTM reports some interesting tests run for the Havre de Grace Pennsylvania Railroad Bridge over the Susquehanna River, started in 1906.[3] High steel panels were painted with three spreading rates, 600, 900 and 1200 sq ft per gal of paint and suspended on the lower deck of the bridge. A brief summary of the evaluation in 1913 showed the following grouping of 18 panels listed in Table 4.

The three paints that rated excellent in all three spreading rates were composed of red lead and linseed oil. However, since that time many new paints have been developed, especially the synthetic types. But the disadvantage of too great a spreading rate with too thin a film is illustrated.

Drying Time

The time each coat of paint takes to dry may be an important factor when determining total time required to paint a given project, especially when several coats and trims are required. Baking coatings at high temperatures shortens the drying time tremendously and baking has become the key to rapid production painting. Drying time is an important factor when planning job timing among a limited number of painters available in a plant.

Tremendous effect of drying time can be seen clearly by a glance at the automotive industry in Detroit.[4] The "nitrocellulose revolution" that came with lacquer paints broke the most critical bottleneck in the automobile production field and pushed the assembly of cars into really high gear. In 1922 it took 30 days to paint a quality car when coats were applied, "thin enough to absorb oxygen". In 1923 a True Blue Oakland was painted in five hours, a remarkable feat. "Duco" cellulose acetate lacquer had been developed by some chemists in Parlin, N. J. The immense savings that resulted can best be presented by simply multiplying this time difference by the 50 million cars in operation today.

The auto painting problem is not yet solved. Paints are still a top item in Detroit research, with their exposure laboratories on mountain tops in Chile all the way to seaside pastures of panels mounted in sunny Florida.

Traffic paints are an outstanding example of a job that demands fast-drying paints. Drying time TO TOUCH will permit working in the area of fresh paint as long as direct contact is avoided. Dust will no longer adhere. For greatest paint endurance the FULL DRY time should be observed before cover or finished coats are applied on top of any given coating. Table 5 lists the time for common industrial paints to reach dryness TO TOUCH and FULLY DRY, together with their spreading rates.

Cost of Labor

Table 1 gives information on the capabilities of the average maintenance painter which will be of assistance in computing painting costs. These capability figures are not to be taken as gospel. They have been checked by our own painters and they are presented purely for estimating purposes or to serve as a guide in planning projects. There are too many human factors that affect the project such as weather, surface conditions, and other items beyond the painter's control to be able to give accurate figures that would apply to all jobs. All of these factors affect the "spreading rate" of the painter on a particular job.

Ultimate Costs

In modern evaluation procedure structures are given fixed annual costs based upon an estimated life expectancy, cost of labor and materials of erection and complete installation less depreciation allowances. In utility operations a 50 ft, class 2 creosoted pine pole may have an annual cost value of about $8.00. Steel towers and sub-station and power plant structures have corresponding annual values, so each year that this equipment is preserved beyond the given life expectancy is clear gain.

Paint is an excellent method of preserving the materials and the structures. Planned painting periods with carefully selected paints pay

[3] H. A. Gardner, A.S.T.M. Proc. 1913, Corrosion, by F. N. Speller, p. 311.
[4] High Gear, in The Laboratory, Dec. 1952, p. 46.

Table 6. With corrosion, low first cost often results in a false economy[5]. Results show paint film must be thick enough if it is to resist corrosion

Assumptions: 100 ft of pipe with 4 fittings and 2 valves; life of piping ends when half of original thickness of wall has been corroded away.

Material	Rate of Corrosion IPY Inches per year*	Wall Thickness of 2 in Pipe Inches	Life (a) Expectancy Years	Total Cost (b)	Cost per Year (c)
Chemical lead	0.008	3/16	11.7	$613.00	$53.00
Durrion	0.006	Sch.40: 0.154	12.8	991.00	78.00
Mild steel	0.270	Sch.80: 0.218	0.4	277.00	696.00
Monel metal	0.046	Sch.40: 0.154	1.7	1,184.00	693.00
Cast iron	0.890	Sch.80: 0.218	0.1	126.00	1,260.00

*IPY data from Tech. Bull. 6-3, Oct. 1948, p. 32, International Nickel Co.

(a) Life expectancy = ½ wall thickness inches ÷ IPY
(b) Total cost should include all labor and materials involved.
(c) Cost per year = total cost ÷ life expectancy.

Table 7. Effect of paint film thickness on resistance to salt fog corrosion Results show how rapidly metal is corroded when paint coverage is too thin

Kronstein's Film Thickness Test Panels [2]

Hours exposed to salt fog	Item estimated	Total thickness of coating, mils: 1.05	4.0	6.65
		Area rusted and appearance of panels*		
0	area rusted	5%	0	0
	appearance	spotted	white	white
96	area rusted	35%	0	0
	cross marks	deep rust	much rust	light rust
248	area rusted	60%	0	0
	cross marks	deep rust	much rust	light rust
418	area rusted	90%	0	0
	cross marks	deep rust	deep rust	deep rust

*Area rusted and appearance of panels and rust marks estimated by this author from photos of panels shown in article.

off in long life. Painting periods have been lengthened by the great strides in paint improvement. Five-year spans between repainting have been lengthened to eight years and soon will be 10 years or more. Cost of repainting is very small compared with the cost of renewing the complete structure or even parts of the assembly.

Table 6 illustrates the fallacy of evaluating materials subject to corrosion in terms of initial investment. The lowest investment cost per 100 ft of cast iron pipe gives the highest annual cost. Medium cost lead pipe becomes the cheapest in terms of average annual cost.

With periodic inspection of painting, the cost per year, based on a 12-year period, is approximately 6.7 cents per sq ft.[8] This is over 50 per cent less than when a complete metal preparation and painting job must be done in three to five years where extensive surface cleaning, brushing, sand-blasting, or preparation of the badly corroded surfaces becomes necessary.

Pierce claims that the annual cost of maintenance painting in a plant may be reduced 42 per cent by sand-blasting metal surfaces before painting. Cost of preparing the surface may be 15 cents per sq ft against about 17 cents per sq ft for the painting operation. The cleaning cost of 15 cents need not be repeated after the painting has once been done. In fact, most steel structures leave the fabricating plant with a ground coat, galvanized, or a sufficiently clean surface for an immediate primer coat, all of which should eliminate the need for surface cleaning if painting is done as soon as erection is complete or galvanizing weathers sufficiently to receive paint. Pierce sets up a minimum film thickness requirement of 5 mils compared with 2 to 5 mils obtained by hot-dip galvanizing and 0.2 to 0.5 mils in electro-plating.

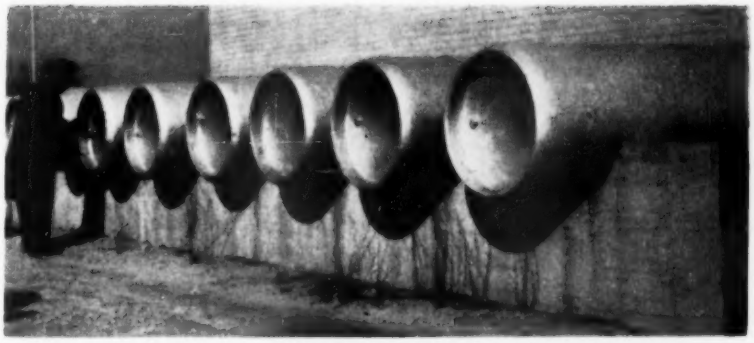


Fig. 3. Aluminum paint used on groups of small gas tanks for reflecting heat and preventing corrosion

Steel towers are being coated successfully with one coat of combination primer-finish coatings, whose protective life is expected to be eight years, against four years for the original galvanizing. The producer of such a primer finish paint, aluminum, gun metal, or color finish, advertises a coverage or spreading rate of over 500 sq ft per gal, which corresponds to a film thickness of about 3.2 mils wet or 2.5 mils hard or dry. It is questionable whether two coats of this paint should be applied at once to procure an immediate 5-mil laminated film that must last 16 years, when single coats give an expected life of eight years, at which time the second coat could be applied to get the second eight-year life extension. Most utilities have found it more economical to apply a single coat at regular intervals rather than apply two coats at longer intervals.

[8] R. Pierce, Chemical Engineering, May 1952, p. 149.

[9] Paul E. Drystow, Corrosion Group, Esso Engineering Dept., Standard Oil Development Co., N. J. p. 204, Chem. Eng. Jan. 1953.

Latest Isotope Weld Testing Technique

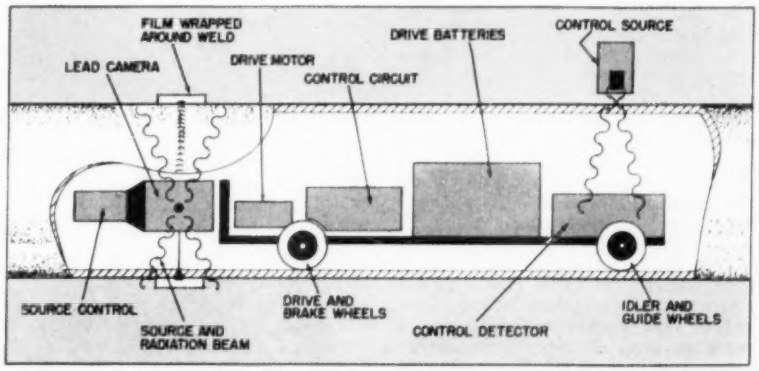
IN GAMMA RAY inspection of welds on "big inch" pipelines, a quick and convenient method is to locate the isotope source in the center of the pipe; wrap film completely around the weld. This provides radiography of 360 deg with one exposure. To make this method possible and virtually automatic, Isotope Products have designed — and are now testing — a mechanized internal camera which is remotely controlled.

The main layout of this unit is shown in the accompanying sketch. The exposure camera, containing the isotope source, is at the front of the unit. When this source is exposed gamma radiation is emitted in a narrow beam through 360 deg. An electric drive motor, powered by two storage batteries and controlled by a radiation detection device, propels the internal camera unit through the pipeline. The control detector, "brain" of this mechanized camera, is located at the rear of the unit.

The operator wraps film around the weld and places the control source at a fixed distance from the weld. Automatically the internal camera runs along inside the pipe, and when the detector reaches a point immediately below the control source, a trigger mechanism cuts the motor and simultaneously applies a power brake. At this point the exposure source is aligned directly with the film wrapped around the pipe and an exposure is made. After a controlled exposure time the unit automatically resumes travel till it is stopped by the control source again.

Isotope Products have just completed radiographic inspection of welds on the section of the Interprovincial Pipeline that crosses the St. Clair River. Similar gamma radiography is being done on the welds of Sun Pipeline — an 8-in. line between Sarnia and Toronto.

For these pipeline weld inspections Isotope engineers use a small portable (25 lb) exposure camera which can be clamped in any position around the exterior of the weld. A film, in a special holder, is fixed around the opposite side of the weld. The camera contains the iridium source in a rotating lead barrel which can be revolved from safe working distance by a long flexible shaft. By this technique — ideally suited for smaller diameter pipe — more than 180 deg of weld can be radiographed with one exposure.



Section through a pipe under test showing isotope source in pipe center with film wrapped around weld

How to Size Piping and Valves for Flashing Mixtures

By W. F. ALLEN, Jr.

Engineer, Mechanical Division
Stone & Webster Engineering Corp.

Since the original articles on this subject were published in 1952, extensive tests by Fisher Governor Company have shown that, for some sizes, smaller and less costly valves than those indicated by the Valve Sizing Chart can be used. Here author summarizes test results

IN THE May, June and August issues, 1952 of POWER ENGINEERING, detailed procedures including sizing charts were presented for designing piping and valves for flashing mixtures. The design formulas and charts were derived on the assumption of a compressible fluid behaving as a uniform mixture in thermodynamic equilibrium at all points in the path of flow. The assumed fluid behavior had been well substantiated by test data for flow in pipes. However, the modest accumulation of data pertaining to valve capacity, which was used to verify that valves sized by the chart were satisfactory, did not show conclusively how much of a factor of safety was included in the valve sizing procedure.

A summary * of the results of the first extensive test program undertaken on control valve capacities for flashing mixtures has been released recently by the Fisher Governor Co. In addition to this information, the writer has had access to a large amount of data covering individual test runs generously made available by Fisher Governor Co. Critical examination of these data reveals that over the range of pressures covered by the tests, modifications may be made safely to the procedures given on the control valve sizing chart, June 1952 issue, which in some cases will result in specifying smaller and less costly valves.† The test program covered a range of pressures from 200 psia to atmospheric pressure and included globe and angle valve designs.

Case I — Compressed (or subcooled) Liquid at Valve Inlet: — The test data verify that with reasonable accuracy valves covered by Case I may be sized as for liquid flow with the pressure drop taken as pressure at valve inlet minus saturation pressure corresponding to liquid temperatures at valve inlet. An exception to this procedure is that valves should not be sized for a pressure drop of more than 75 per cent of inlet pressure regardless of the amount of compression.

Case II — Saturated Liquid at Valve Inlet: — Globe type valve capacities obtained on test with saturated liquid at valve inlet are greater than predicted by formula and shown on the control valve sizing chart. The test data may be correlated if capacities are calculated using the critical pressure ratio, Fig. 1, May 1952 issue, and a fixed liquid volume instead of a variable volume. Therefore, with reasonable accuracy, globe type valves may be sized as for liquid flow with the pressure drop taken as valve inlet pressure minus throat pressure. Throat pressure equals the product of critical pressure ratio from Fig. 1 and inlet pressure.

This modified procedure applies to a number of angle designs with full size inner valves. However, one type of angle valve with full size inner valve and all angle valves with reduced size inner valves evidenced capacities on test more in line with the curve shown on the control valve sizing chart.

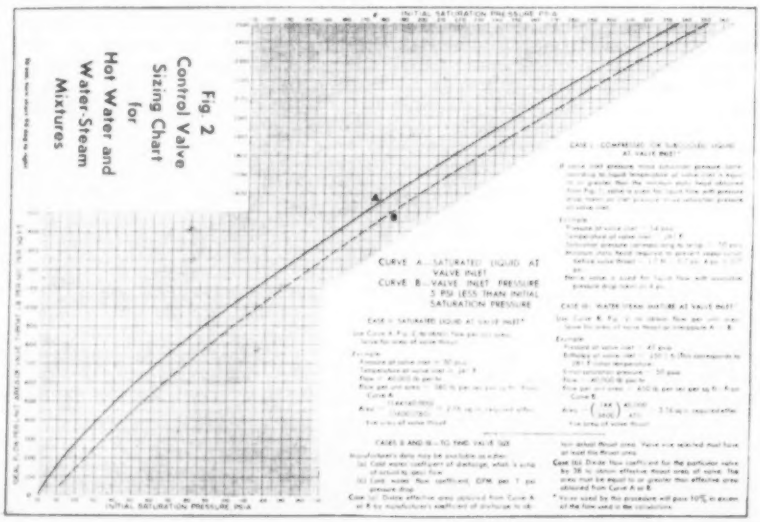
At pressures above 200 psia, it is recommended that the valve sizing chart in its present form be used, tempering the procedure in border line cases with the knowledge of increased capacity over that given by the chart at lower pressures. Usually control valves for high pressure service are relatively small and the saving in first cost for a valve sized by the modified procedure instead of by the valve sizing chart is small. On the other hand, for pressures below atmospheric, substantial savings in valve costs may be realized in many instances because of the large sizes involved and it is suggested that globe valves be sized by the modified procedure.

Valve capacities obtained on test with water-steam mixtures at valve inlet are greater than predicted by formula also, but this additional capacity should not be considered unless substantiated by the manufacturer's test data for the same or approximately the same conditions of pressures, temperature, size and type. In all doubtful cases with angle valves and in the absence of specific test capacity data from the manufacturer, it is recommended that the curves shown on the control valve sizing chart be used.

The author has reprints available of the three original articles which contained the full-size control valve sizing chart shown below. For copies of these, write to W. F. Allen, Jr., Stone and Webster Engineering Corp., 49 Federal Street, Boston 7, Mass.

* Sizing Control Valves Handling Flashing Liquids, by Glenn F. Brockett and Charles F. King, Fisher Governor Co.

† The responsibility for the particular interpretation of the test results given herein rests solely with the writer.



Miniature reproduction of 7 x 10 chart included by Mr. Allen in his original articles, as noted above

LETTERS TO THE EDITORS

Fuel Oil Additives

THIS IS TO acknowledge your letter with which you were so kind as to send us photostat copies, free of charge, of the article on Fuel Oil Additives from your Feb., 1949 issue.

We also are indebted to you for the other sources of information on fuel oil additives you have mentioned. We are greatly interested in this subject, and we will get in touch with the sources you mention.

We are extremely obliged for your good attention in this respect, and wish to put on record our appreciation of the valuable assistance you have rendered us in our quest for information on this whole subject.

G. GOMEZ

Buenos Aires, Argentina

Editor's Note: — Mr. Gomez is an engineer with Drillex, Industrial Engineers, of Buenos Aires.

Engines in Milk Plants

I HAVE seen POWER ENGINEERING several times, getting it from the chief engineer at a nearby milk plant.

When I look at the magazine, I look to see if any of the condenseries or other milk plants in Wisconsin have pictures showing their power equipment.

The only engineering magazine I ever saw to have pictures of power equipment in a condensery was 25 years ago. It was *Power Plant Engineering* (now POWER ENGINEERING).

In late years, I have been making a study of the makes of engines used in creameries and skimming stations. These were from 5 to 20 hp in capacity. The makes were: Victor, Erie, Frost, Atlas, Richards Iron Works, Crepaco, Frick, Watertown, Jewel, Gem, and Clark. I wonder if you or your readers ever heard of those makes.

Reason I wrote about this is because the steam engine is about gone as power for a creamery. My uncle ran a creamery at one time that had an 8-hp Frost. This ran two separators and a churn.

SCOTT MCCORMICK

Princeton, Wisc.

Drying Problems

PAUL C. ZIEMKE in his article in your May issue, page 73, on Silica Gel Drying Problems, after some excellent comments on drier operation, makes the statement that he used three silica gel driers on one particular job and did not achieve complete absorption of entrained moisture. However, the use of one Drierite unit completely cleared up the situation.

This statement is misleading in that silica gel has much higher absorption capacity than Drierite in systems having a high moisture content. Drierite has a maximum moisture capacity of approximately 6.5 per cent; whereas silica gel can absorb up to 40 per cent of its weight in moisture. Naturally, if a system has a large amount of moisture in it, one silica gel cartridge may not be able to absorb all of it.

However, a single Drierite cartridge would be less effective than the silica gel cartridge. If three silica gel cartridges were required for the preliminary clean-up of moisture, it might take up to six Drierite cartridges for same job.

We feel it important to bring this to your attention since silica gel is the most widely used refrigerant desiccant in use today, and has been thoroughly proved through years of satisfactory use.

Baltimore, Md. R. H. HERRMANN

Editor's Note: — Mr. Herrmann is technical service engineer with The Davison Chemical Corp.

Spooks and Gremlins

HAVE been trying to adjust in my dense cranium those replies anent that squib "Spooks and Gremlins" in April issue, and for the life of me can't line up the answers sensibly.

Mr. Fisher, New Haven, suggested sump'n in the feedwater. Quite probably there is some minor impurity in the feed besides pure water. But in the high pressure mains after that water is evaporated, the steam should be pure H_2O and actually is. At two widely separated locations, pharmacy and chemical labs, they run off pure distilled water containing only a trace of ferric oxide, presumably from pipe rust. Carryover of soda or phosphate boiler compounds such as we use, and which are in common use, would ruin this distilled product for pharmaceutical and laboratory purposes, yet to date there hasn't been one squeak about its purity.

A well known chemical company gets regular samples of content from all boilers, analyses and prescribes the correct treatment indicated with outstanding results. Very seldom have had to put turbine through a tube; just paper-thin scale on interior surfaces that flakes when dried.

Mr. Rule, Princeton, leans more toward my suspicion of electrolysis. He suggests driving a brass rod 2 ft into the ground with copper collar and tie from pipe to rod. Easier said than done here. In all our 10 acres of buildings, the nearest place we could find sufficient terra firma to drive a needle into is 200 ft away, all else is concrete areaways. However, we do ground to sewers and city mains and keep fingers crossed till further evidence appears in court.

Let's hear from you again, fellows; I do enjoy a good scrap even if only a printed one; my mother was a Kelly.

A. E. RICHARDS

Toronto, Canada

Ten Commandments for Technical Men

I — Thou shalt not follow in the dust of progressing operations but shalt run ahead with a lantern in thy hand to reveal the way.

II — Thou shalt seek and respect the opinions of operators, even unto the third helpers, for theirs is a wisdom unknown to technocrats.

III — Thou shalt determine what should be done and do it without the necessity of others holding thy hand.

IV — Thou shalt not be too dignified to shoot the bull; neither shalt thou shoot it entirely, for so is its productivity destroyed.

V — Thou shalt not forsake the ways of thy technical training so that to thee CH_2O* ceases to be formaldehyde and becomes sea-water.

VI — Thou shalt not take thy grievances and ideas first to the top, lest the bottom remove its support from under thee, saying, "We knew nothing of it."

VII — Thou shalt remember that manufacturing and refining processes change not because of reasoning and meditation, however profound, but only by the turning of valves.

VIII — Thou shalt study thy conclusions from all sides through many viewpoints, for verily, undiscovered claws may rip thy rear.

IX — Thou shalt strive to make thy judgment as good as any man's by experimenting, observing, recording, calculating, studying, and thinking; and having done so,

X — THOU SHALT USE IT.

Editor's Note: — These commandments were transmitted to us by Robert Henderson Emerick, consulting mechanical engineer, author of the famous stories about Oscar, the Gas Works Owl, and other articles in POWER ENGINEERING.

* And even a "Technocrat" can make a slip — The Author.

140% Return on Small Boiler Modernization

This du Pont plant, with four old 15,000 lb/hr 150 psi boilers, modernized combustion control and draft . . . saved $7000 a year . . . 140% investment return. Author tells how they did it and discusses economics of modernization

By R. L. STEELE

Engineering Department, E. I. du Pont de Nemours & Co., Inc.

THE STOKER-FIRED boiler plant at our Barksdale Works is probably similar to many others that were constructed during the period 1915 to 1925. It consists of four Edgemoor 2-drum horizontal inclined straight-tube boilers, fired by Combustion Engineering Type E stokers. Rated steaming capacity of each boiler is 15,000 lbs per hr of dry and saturated steam at 150 psi. Combustion control in this type of boiler varies from practically manual to fully automatic, depending on the type of load it must supply.

Before we decided to modernize, combustion control was semiautomatic. Combustion air was supplied by a large steam-engine-driven forced draft fan that was too sluggish for both the existing and proposed control systems. Boilers supply steam for chemical processes and steam-driven air compressors, and for this type of load good combustion control is essential apart from the improved boiler performance and reduced operating costs it gives.

Our old system was not giving us the results we wanted, so we decided to investigate the possibility of modernizing the forced draft and combustion control system to see if the expenditure could be justified. Since our boilers were still in good condition, we wanted to make the system as modern as possible and still retain the old boilers.

Old System

In the following paragraphs the old system will be described, and the reasons for selecting particular equipment given as well as a description of the new equipment. The results we achieved and the savings realized will also be discussed, followed by a general discussion of the installations costs.

It may be stated here that operating savings of approximately $7000 per year were realized and that previous operating difficulties were eliminated.

Before our recent modernization program, our boilers were controlled as shown schematically in Fig. 1. It will be seen that the master controller varies the speed of the engine-driven forced fan to control combustion air for all four boilers. In other words, all boilers were controlled as one as far as combustion air was concerned.

The speed of the four stokers, or rate of coal feed, was also controlled by the master controllers. The stoker control valves were in parallel with the master, so the fuel fed to all boilers was also controlled by the master. The rate of fuel feed could be readjusted by biasing the various selector valves, but otherwise the rate of fuel feed was the same for all units.

This system had a number of disadvantages. There was virtually no control of the air flow through each individual fuel bed. If one boiler had a heavy fire when at the same time the other boilers had light fires, the air would follow the course of least resistance and the fire which needed more air would get less. Operation was difficult, performance was poor, and though this could be controlled to some extent by manual adjustment of the stoker selector valve, this often proved unsatisfactory because the firemen could not possibly detect changes in control conditions as fast as the master controller.

Furthermore, a heavy fire often had to be carried in one unit because differences in coal size made it impossible to get proper air distribution to the four boilers. When one heavy fire was needed, it was necessary to boost the forced draft to get enough air to the heavy one. As a result, the other fires got lighter and good control became practically impossible.

Another handicap of the old system was the engine-driven forced draft fan. It was rated at 37,500 cfm at 5 in. S.P. at 330 rpm. The fan rotor diam was 8 ft. The engine driving the fan was a vertical 10 in. by 10 in. D slide valve type. As this unit possessed considerable inertia, changes in speed called for by the master controller were slow.

It required approximately 1 min to accelerate the unit 100 rpm. This caused hunting in the master controller unless the range of pressure over which the master operated was unduly large, and resulted in boiler pressure changes as much as 10 lb during load swings. Swings of this magnitude were too great for our engine room and various process users.

An additional disadvantage of the old system was the bad effect it had on boiler maintenance. Poor control of combustion air shortens grate and refractory life and spoils boiler performance.

New System

There were two engine-driven fans in our boiler room. One engine was fairly new, but the other was in very poor condition and could not be repaired economically. We considered replacing one of the forced draft units with a modern forced draft installation instead of just replacing the old engine alone. At the same time, since the combustion control system described above was unwieldy and did not give satisfactory boiler performance, we considered revamping our combustion control system to give individual control of combustion air and automatic adjustment of fuel feed for each boiler from steam flow-air flow meters.

When we checked the cost of modernizing our forced draft installation, we found that the turbine-driven inlet vane controlled forced draft fan could be bought and installed for about 30 per cent more than it would cost to replace the engine alone. Equipment costs for both cases were about the same, but the new unit required equipment rearrangement which increased the installed cost. We decided to buy the modern unit; in addition to providing an adequate responsive air supply, the new unit would also be much cheaper to maintain than the reciprocating engine.

It might be well to note that our exhaust steam balance justified a turbine-driven fan, but in plants without exhaust steam, an electric motor drive would be equally satisfactory and probably would be more economical.

When we checked the cost of modernizing our combustion control system, we found that the expenditure required could easily be justified. The system we selected is shown in Fig. 2. The same system without the averaging relays and steam flow-air flow adjustments had been considered. However, this system was not adopted because it would have been subject to a great deal of human error, since air flow or fuel flow would have to be adjusted manually, and it has been the writer's experience that automatic systems give a lot of trouble if much readjustment by the operator is required.

For this reason, and the high investment return (see below), the control system shown in Fig. 2 was chosen. We estimated that the proposed changes in the control system would result in an over-all savings of at least $7000 per year. It would yield a gross return on investment of about 140 per cent. Gross return is given since methods of calculating net returns vary considerably with the type of industry. In some cases the net return might be as much as 100 per cent, while in others it might be as low as 25 per cent, because of tax structures, methods of calculating depreciation, etc. When calculating the savings, we assumed that boiler efficiency would be at least 2 per cent and boiler maintenance costs would decrease about 4 per cent.

Combustion Control System

Before discussing savings and results, here are a few remarks about the improved control system. The master controller transfers header steam pressure into an air loading pressure that is transferred both to the forced draft damper selector valves and to one side of each averaging relay. The other side of each averaging relay receives loading pressure from the steam flow-air flow meters. Any unbalance of pressure in the averaging relay causes the stoker speed to change in order to correct the unbalance.

When air and fuel conditions are normal, the steam flow-air flow meter pens run together, but with too much air or too little fuel or any other faulty condition the pens move apart and the control mechanism in the boiler meter corrects the faulty condition by re-adjusting the stoker speed through the averaging relay. Figure 3 shows the great improvement in control that was obtained with the new system.

An important point about the system and one that is not always appreciated is the need to have a time lag in the boiler meter output loading pressure. This is to keep the system stable by ensuring that the master controller has precedence over the boiler meter portion of the controller system, and it is achieved by having a needle valve in the line from the boiler meter to the averaging relay.

With this type of unit, it is essential that the steam flow (fuel flow)-air flow compensation be achieved through the stoker speed and not through the air flow, since these units are more sensitive to air flow changes than to changes in fuel flow. If the air flow were not controlled through the master controller only, the steam flow-air flow compensating mechanism would take precedence over the master and thereby make the system unstable and slow to respond to load changes. A boiler fired with oil, gas, pulverized coal or spreader stoker is more responsive to fuel flow than to air flow, hence readjustment from the boiler meter is made by changing the air flow rather than the fuel flow as in underfeed or chain grate stokers.

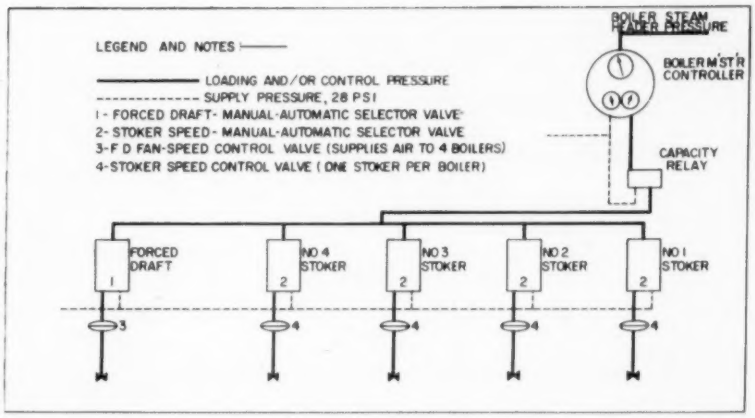

LEGEND AND NOTES
LOADING AND/OR CONTROL PRESSURE
SUPPLY PRESSURE, 28 PSI
1- FORCED DRAFT- MANUAL-AUTOMATIC SELECTOR VALVE
2- STOKER SPEED- MANUAL-AUTOMATIC SELECTOR VALVE
3-F D FAN-SPEED CONTROL VALVE (SUPPLIES AIR TO 4 BOILERS)
4-STOKER SPEED CONTROL VALVE (ONE STOKER PER BOILER)
BOILER STEAM HEADER PRESSURE
BOILER M'ST'R CONTROLLER
CAPACITY RELAY
FORCED DRAFT
NO 4 STOKER
NO 3 STOKER
NO 2 STOKER
NO 1 STOKER

Fig. 1. Combustion control system before modernization. No individual combustion or fuel feed control

Another feature of our new system is the control of the forced-draft fan. The duct pressure controller maintains constant duct pressure by varying the position of the inlet vanes on the forced draft fan, thus the air supplied to any one boiler is a direct function of forced draft damper position only.

Other features of our control system, not shown on the sketch, are automatic furnace draft control and the control set-up for the other forced draft fan that serves as a stand-by. In this case the duct pressure controller varies the speed of the fan through a control valve in the inlet steam line to the fan engine.

Results

With our new combustion control system, variations in header pressure have been reduced substantially. Furthermore, steam pressure remains very near the control pressure continuously, while with the old system it often remained below the standard for extended periods, because of the fires in respective boilers becoming dissimilar, as described under disadvantages of the old system .

Figure 3 shows typical boiler meter charts before and after the changes and it is seen that there has been a

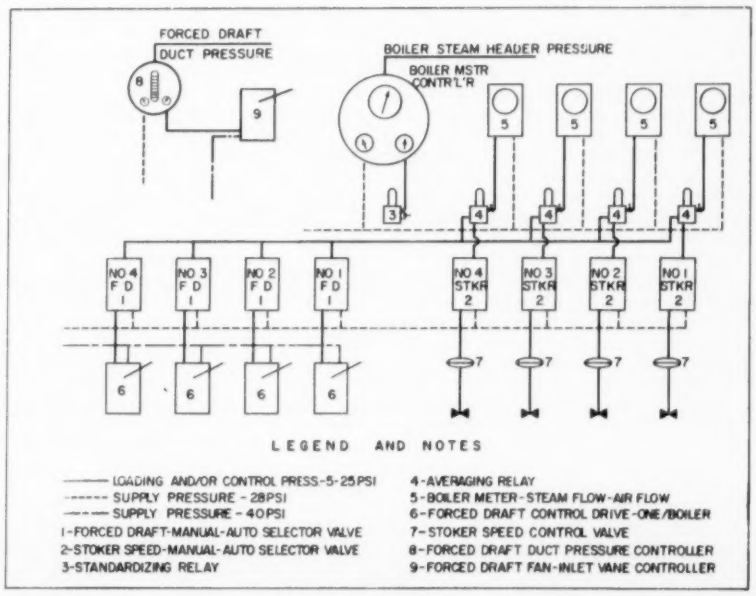


Fig. 2. Combustion control after modernization, with individual control of combustion and fuel feed control

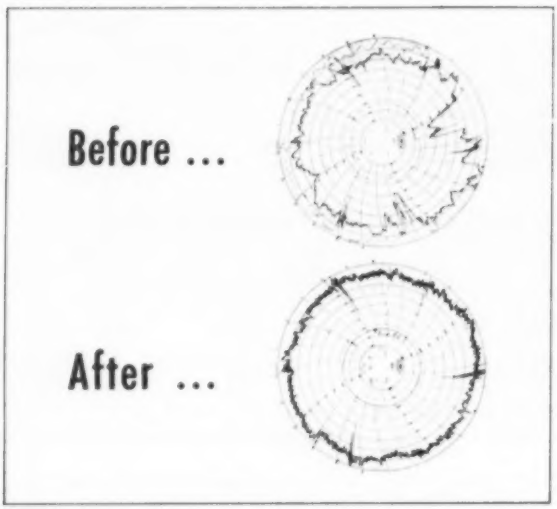


Fig. 3. Typical boiler meter charts before and after control modernization

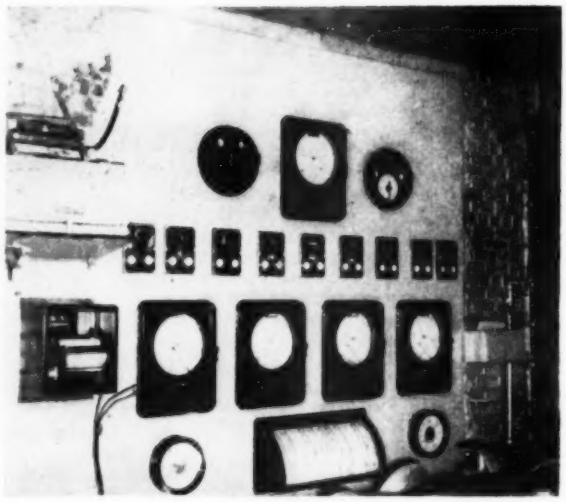


Fig. 4. Control board location of instruments shown schematically in Fig. 2

distinct improvement in combustion control. Excess air necessary for satisfactory operation was reduced since the air flow pens were brought together and track each other well during load swings. It may be asked why it was necessary to carry the pens so far apart when operating under the old system. This may be answered by referring the reader to the statement made previously about uneven air flow where one fire became heavier than the others.

Other improvements, resulting from the new controls, that are not shown by the charts are as follows:

1. Ash-pit losses were reduced considerably. In the old system, when the percentage of fines in the coal was high and when loads were heavy, a large quantity of coke was formed. With the new system, coke in the ashes can hardly be visually detected.

2. We have no difficulty at all getting good air distribution to all boilers under all load conditions. Fires no longer build up or get too light.

3. Lighter fires can be carried which results in rapid response to load swings.

4. Maintenance has been reduced since there is now no tendency for holes to develop in the fires for reasons 2 and 3. Eliminating holes in the fire reduces wear and tear on grates and furnace walls.

5. We have greatly increased our steaming capacity. At present we are carrying a greater load with three boilers than was previously economical to carry on four. Without the new controls, we would not be able to carry out our annual repair schedule of boilers without curtailing production or adding extra manpower to do the work on weekends, which would have increased operating costs.

This last improvement would have been enough alone to justify the new system, had the increased steam demand been known when the new system was being considered. In effect, the controls have increased the plant steaming capacity by about 25 per cent.

To date, it has been impossible to prove some of the figures given above by actual evaporative tests. However, from examination of monthly performance figures that include average monthly boiler efficiency, maintenance costs, and other actual operating observations, it may be safely stated that predicted savings have been met. These were a 2 per cent increase in boiler efficiency and a 12 per cent decrease in boiler room maintenance. Actually, it is believed that boiler efficiency has been increased about 3 per cent, and maintenance costs have been decreased 15 per cent.

Costs and Investment Returns

It is difficult to make definite cost statements since the installed cost of equipment of this type depends a great deal on the plant in which it is installed. In some plants a new fan and turbine would require extensive rearrangement of existing equipment while in other plants the new equipment could be installed with hardly any change at all.

The same would also apply to the combustion controls though not quite so much. Erection costs of the kind of fan and turbine we installed could easily run sometimes as low as $1000.00 while in others it might run as high as $4000.00. Installation costs of the control system could vary from a low of $1500.00 to a high of about $2500.00. The high figure would apply where the existing control panel would have to be replaced. The low figure would apply where the additional controls can be installed in an existing panel without moving any of the existing controls.

As a general figure, the additional controls for a bank of four boilers of the type could be purchased and installed for about $5000.00, while the total installed cost of a fan and turbine for a boiler or bank of boilers with a steaming capacity of around 80,000 lbs per hr could be purchased and installed for a total cost of about $7500.00. The cost of the control system would be reduced considerably, of course, if controls were bought for one boiler only instead of four.

Justify Combustion Controls

Since gross return on investment to be expected from a modernization program will depend on the total installed cost of equipment, the price of fuel, load characteristics and operating labor, the return will vary from plant to plant. The gross return in this case was 140 per cent. This is quite high because the old equipment was obsolete and the combustion control was very poor. The return would have been reduced substantially had there been only one boiler to control instead of four.

It is doubtful whether steam flow-air flow compensation could be justified in many cases where there is only one boiler to control. With one boiler only, it is quite easy for the fireman to bias the air manually by means of the forced draft selector valve and he can approach the degree of control that is possible with automatic compensation. It would also be difficult to justify a control system of this type in plants where only a small amount of fuel is burned or where there is plenty of by-product fuel. However, in most cases where controls are now obsolete or inadequate, the investment required for modernization can nearly always be justified.

For a rough idea of savings resulting from installation of combustion controls, it is safe to assume an efficiency increase of 1 per cent and for stoker fired boilers a decrease in maintenance cost of about 10 per cent if your boilers are operating at or above rated capacity. This statement is based on the writer's experi-

(Continued on page 128)

Power Engineering's

PRACTICAL ENGINEER and ELECTRICIAN SECTION

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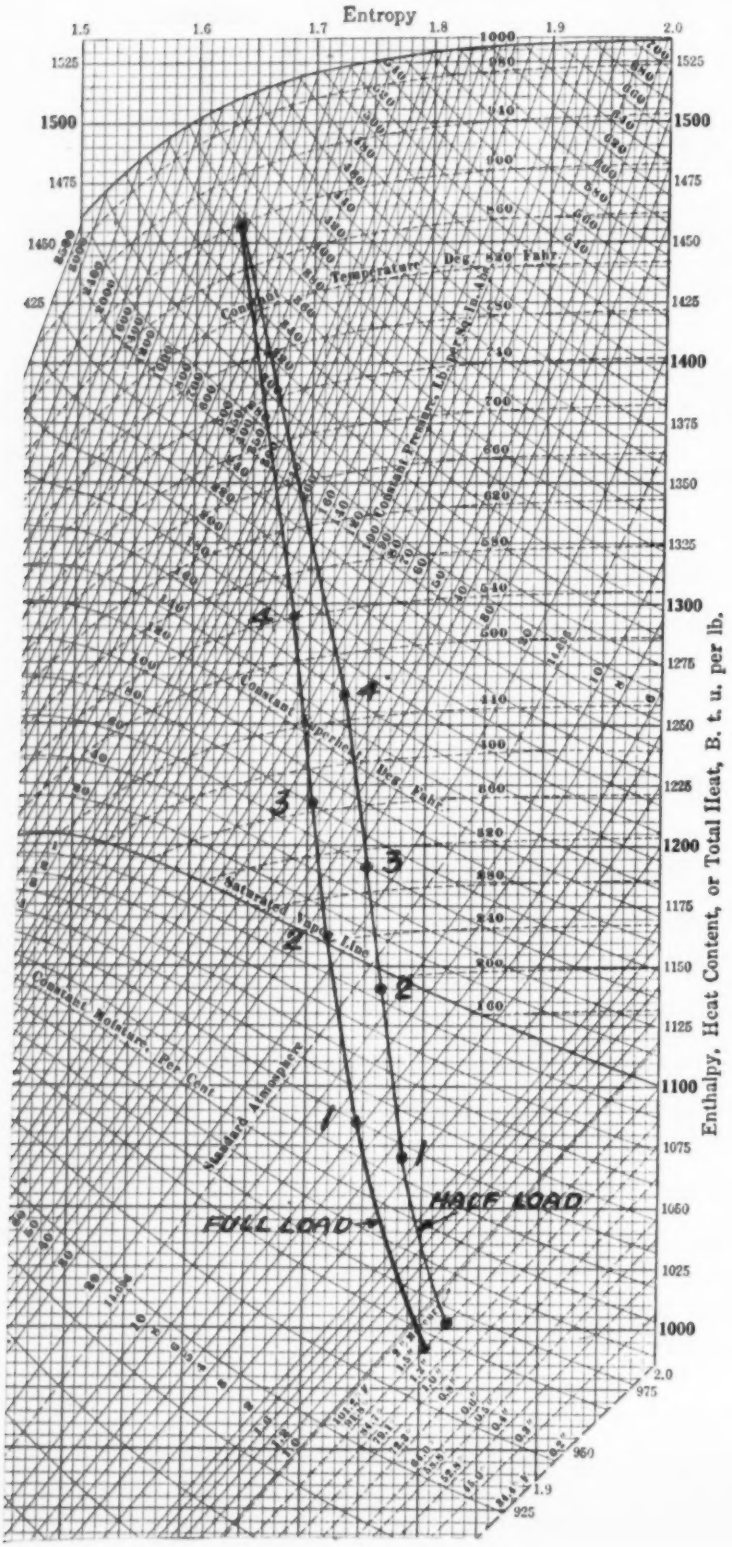
Basic Power Plant FIGURING

How to Tell if a Given Steam Turbine Will Fit Your Conditions



By

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TURBINE design is a very specialized field, and turbine development is work for specialists. Even though turbine design is complicated, however, it is not very difficult for the power operating engineer to do the necessary figuring to find out how a particular turbine, of known characteristics, will fit into his plant. The example given here is intended to show how easy it is.

Figures for a 20,000-kw unit are shown. The values are given as they might appear in data supplied by a turbine manufacturer in submitting his bid.

The machine in the example has four extraction openings, therefore it may be called an *extraction* turbine. However, the design is intended to supply extraction steam for feedwater heating only, in a regenerative cycle, and for this reason, some manufacturers prefer to use the term *regenerative* in describing a machine of this type.

A rule of thumb often used is that not over 15 per cent of the throttle steam should be extracted through one opening, and not over about 30 per cent through two or more openings unless the turbine is designed for it, if serious losses of efficiency and load capacity are to be avoided. This obviously rules out extraction of large amounts of steam for heating, processing and similar uses.

Assumptions in Design

Some of the assumptions made in the design for the example given should be mentioned. The steam conditions at the throttle, and the four extraction points (the regenerative cycle) increase the cost of the unit, but are justified by the increased efficiency in a unit of the size. All auxiliaries are electrically driven. No make-up feedwater is considered except that which is lost in the glands of the turbine itself. Normal amounts of makeup water, to replace losses, will not be sufficient to affect the data noticeably.

Fig. 1. Expansion curves, full load and half load, for 20,000 kw turbine, as plotted on the Mollier diagram. Calculations for this unit are given in the text (p. 102). Numbers refer to the extraction points

All heaters are assumed to "float" with the turbine, and all pressure changes with the electrical load. To account for friction in the piping, the pressure in each heater is assumed to be 5 per cent less than the absolute pressure of the extraction nozzle serving it. It is assumed that the open deaerating heater heats the feedwater to saturation. In the closed heaters, Nos. 1, 2, and 4, the feedwater flows through tubes surrounded by the extraction steam. The steam is condensed and flows through a trap to the next lower pressure stage. It is assumed that the feedwater is heated to within 5 F of this condensate or drain temperature. The work of the condensate or hotwell pump and boiler feed pump have been neglected.

Duration vs. Low Load

It will be noted that at about ¼ rated load, the pressure in the deaerating heater drops below atmospheric, and deaeration becomes impossible. Because of low efficiency, it is not desirable to operate at this low load, but where it is necessary, the heater can be supplied by the higher-pressure extraction opening.

Condensate pump for this cycle must be able to handle its maximum flow at the highest pressure reached in this heater, which will occur at maximum permissible overload.

Purpose of the drain cooler may not be obvious. At rated load, the drain of the No. 1 heater is 20,525 lb per hr at a temperature of 173 F, and this is to be returned to the condenser hotwell, where the pressure is 1.5 in. Hg, and the saturation temperature 91.7 F. The enthalpy of the drain is 81 Btu per lb greater than the enthalpy of saturated liquid in the hotwell. Therefore 81 divided by 1042 or 7.78 per cent of the drain would flash into steam as it entered the hotwell, or 1595 lb per hr at 444.9 cu ft per lb, or 11,800 cfm. The drain cooler eliminates most of this flashing, to simplify piping problems where the drain enters the condenser. With the 10 F temperature difference shown, the flash volume is about 1500 cfm.

Values given in the accompanying example are for one-half and full load. In general, the turbine manufacturer would supply data for one-fourth, three-fourths, and an overload (usually 10 per cent) as well.

Willans Line

Both the Willans Line and a curve of steam rate, lb per kwh are shown. Actually, the Willans Line is not necessary for calculation purposes. It is useful for testing, however. Any data or readings taken during a test are open to question. If the readings taken are plotted, the Willans Line should be smooth and nearly straight. If it is curved, it should be steeper at high loads, like the example. If the readings taken during a test do not form a smooth curve, errors in the data are indicated.

It will be noticed that the minimum steam rate falls at less than three-fourths of rated load. This is not the most efficient operating point. At the minimum steam rate, the load is 14,000 kw, and the pressure in the No. 4 heater is 90 psia. The feedwater entering the steam generator is therefore at 325 F. At full load, as shown in the calculations, the heater pressure is 136.14 psia, and the feedwater is at 345.8 F, and although the steam-generator must supply more steam per kwh, the heat supplied per pound of steam is less, and in this particular case, the heat rate in Btu per kwh is less at full load. This point is mentioned because it contradicts a long established operating rule.

Heat Balance Calculation

To calculate a heat balance (chasing Btu's around) is simple and requires only plain arithmetic. Full knowledge of steam, whether wet, dry or superheated is essential, also interpolation of the steam tables. The Thermodynamic Charts by Ellenwood-Mackey are a great time saver, since the values of steam under any condition may be read directly.

References: Kent, Mechanical Engineers' Handbook (Power Volume); John Wiley & Sons, Inc. Marks, Mechanical Engineers' Handbook, McGraw-Hill Book Co. Potter, Steam Power Plants, The Ronald Press Co. McNaughton, Elementary Steam Power Engineering, John Wiley & Sons, Inc. Zerban & Nye, Steam Power Plants, International Textbook Co.

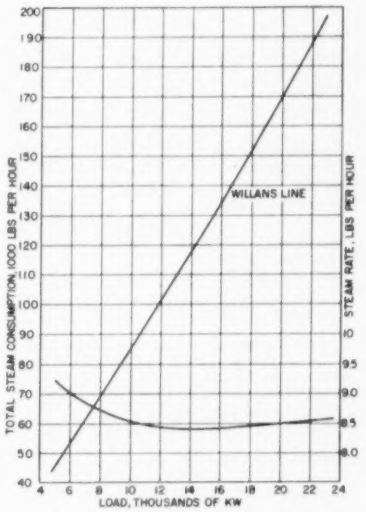


Fig. 2. Willans Line and steam rate curve for 20,000-kw turbine generator unit figured in text

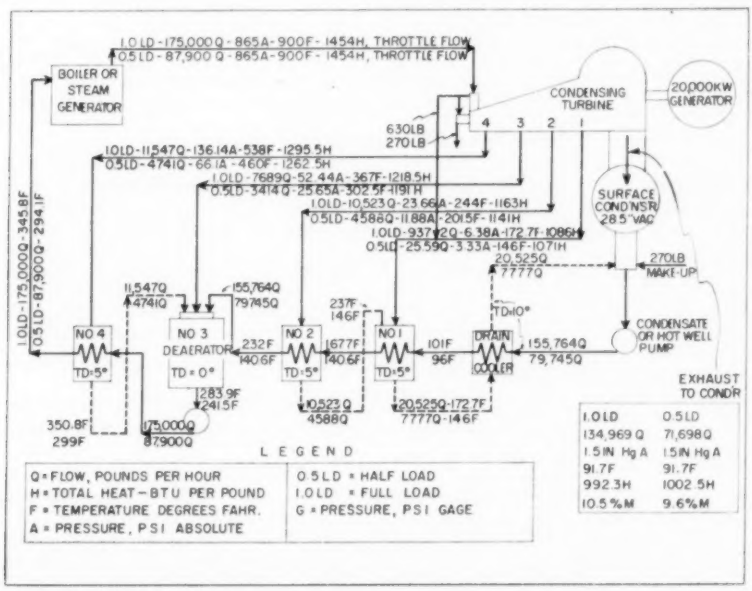

1.0 LD - 175,000 Q - 865 A - 900 F - 1454 H, THROTTLE FLOW
0.5 LD - 87,900 Q - 865 A - 900 F - 1454 H, THROTTLE FLOW
BOILER OR STEAM GENERATOR
CONDENSING TURBINE
20,000 KW GENERATOR
630 LB
270 LB
1.0 LD - 11,547 Q - 136.14 A - 538 F - 1295.5 H
0.5 LD - 4741 Q - 66.1 A - 460 F - 1262.5 H
1.0 LD - 76,89 Q - 52.44 A - 367 F - 1218.5 H
0.5 LD - 3414 Q - 25.65 A - 302.5 F - 1191 H
1.0 LD - 10,523 Q - 23.66 A - 244 F - 1163 H
0.5 LD - 4586 Q - 11.88 A - 201.5 F - 1141 H
1.0 LD - 937 12 Q - 6.38 A - 172.7 F - 1086 H
0.5 LD - 25.59 Q - 3.33 A - 146 F - 1071 H
SURFACE CONDENSR 28.5" VAC
20,525 Q 7777 Q
270 LB MAKE-UP
11,547 Q 4741 Q
155,764 Q 79,745 Q
237 F 146 F
TD=10°
NO 4
NO 3 DEAERATOR
NO 2
NO 1
DRAIN COOLER
155,764 Q 79,745 Q
CONDENSATE OR HOT WELL PUMP
TD=5°
TD = 0°
232 F 140.6 F
167.7 F 140.6 F
101 F 96 F
EXHAUST TO CONDR
1283.9 F 241.5 F
350.8 F 299 F
175,000 Q 87,900 Q
10,523 Q 4588 Q
20,525 Q 172.7 F 7777 Q 146 F
1.0 LD 134,969 Q 1.5 IN Hg A 91.7 F 992.3 H 10.5 %M
0.5 LD 71,698 Q 1.5 IN Hg A 91.7 F 1002.5 H 9.6 %M
LEGEND
Q = FLOW, POUNDS PER HOUR
H = TOTAL HEAT – BTU PER POUND
F = TEMPERATURE DEGREES FAHR.
A = PRESSURE, PSI ABSOLUTE
0.5 LD = HALF LOAD
1.0 LD = FULL LOAD
G = PRESSURE, PSI GAGE

Fig. 4. Heat balance diagram — regenerative feed heating cycle — for 20,000-kw steam turbine generating unit. Steam conditions: 865 psia, 900 F, 1.5 in. Hg absolute; 4 stage heaters and 1 drain cooler

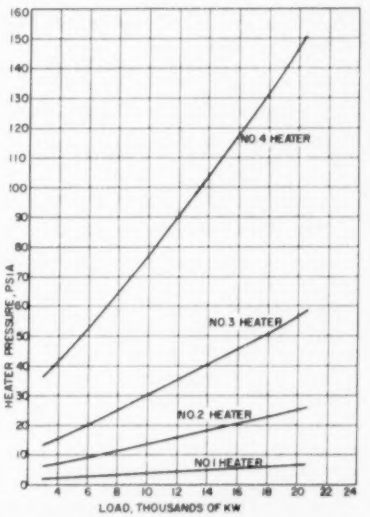


Fig. 3. Heater pressures v electrical load, 20,000-kw turbine. Extraction for feed heating only

Table I. Heat balance for a 20,000-kw turbine generator at FULL LOAD. Operating condition: 865 psia, 900 FTT, 1.5 in. Hg abs, 0.876 pf, 20,602 kw, 175,000 lb steam per hr.

Item	Init. Steam	Extraction Points				Exhaust
		No. 4	No. 3	No. 2	No. 1	
1. Press. psia at turbine	865.0	143.30	55.22	24.90	6.72	1.5 in. Hg
2. Press. psia at heaters	——	136.14	52.44	23.66	6.38	——
3. Total steam temp. F	900.0	538.0	367.0	244.0	172.7	91.7
4. Sat. steam temp. F	527.3	350.8	283.9	237.0	172.7	91.7
5. Degrees superheat F	372.7	187.2	83.1	7.0	5% M	10.5% M
6. Enthalpy, Btu per lb	1454	1295.5	1218.5	1163.0	1086.0	992.3
7. Enthalpy drop in turbine	——	158.5	77.0	55.5	77.0	93.7
8. Enthalpy drop to heaters	——	158.5	235.5	291.0	368.0	461.7
9. Extraction factor	1.0	0.657	0.490	0.370	0.203	——
10. Steam extracted lb per hr	——	11,547	7,689	10,523	9,372	——
11. Added at throttle, lb	——	7,580	3,767	3,893	1,902	——
12. F.W. temp. leaving heaters	——	345.8	283.9	232.0	167.7	91.7
13. Entropy	1.632	1.693	1.712	1.724	1.747	1.860
14. Volume, cu ft per lb	0.89	4.25	9.20	17.4	56.0	400

Table II. Heat balance for a 20,000-kw turbine generator at HALF LOAD. Operating condition: 865 psia, 900 FTT, 1.5 in. Hg abs. 0.85 pf, 10,304 kw, 87,900 lb steam per hr.

Item	Init. Steam	Extraction Points				Exhaust
		No. 4	No. 3	No. 2	No. 1	
1. Press. psia at turbine	865.0	69.6	27.00	12.50	3.50	1.5 in. Hg
2. Press. psia at heaters	——	66.1	25.65	11.88	3.33	——
3. Total steam temp. F	900.0	460	302.5	201.5	146	91.7
4. Sat. steam temp. F	527.3	299	241.5	201.5	146	91.7
5. Degrees superheat, F	372.7	161	61.0	0.5% M	5.25% M	9.6% M
6. Enthalpy, Btu per lb	1454	1262.5	1191	1141	1071	1002.5
7. Enthalpy drop in turbine	——	191.5	71.5	50.0	70.0	68.5
8. Enthalpy drop to heaters	——	191.5	263	313	383	451.5
9. Extraction factor	1.0	0.576	0.417	0.307	0.152	——
10. Steam extracted lb per hr	——	4,741	3,414	4,588	2,559	——
11. Added at throttle, lb	——	2,731	1,424	1,409	642	——
12. FW temp. leaving heaters	——	294.1	241.5	140.6	96.0	91.7
13. Entropy	1.632	1.736	1.754	1.766	1.790	1.825
14. Volume, cu ft per lb	0.89	8.0	17.3	32.5	102	400

Calculations for Full-Load Heat Balance

Throttle flow, straight condensing ..... 156,958 lb per hr
Added at throttle, 7,580 + 3,767 + 3,893 + 1,902. 17,142 lb per hr
Total required at throttle ..... 174,100 lb per hr
Steam extracted, 11,547 + 7,689 + 10,523 + 9,372 39,131 lb per hr
Exhaust steam to condenser ..... 134,969 lb per hr

Total flow is 174,100 + 270(glands) + 630(packing) 175,000 lb per hr

The extraction factor (item 9) is a very convenient method in calculating the amount of steam that must be added at the throttle to compensate for the steam extracted at some point. It is always less than 1.0 and is found thus:

$$\text{Extraction Factor is } 1 - \left\{ \frac{\text{Btu drop from initial to extraction point}}{\text{Total Btu drop from initial to exhaust}} \right\}$$

Example: At No. 4, 11,547 lb of steam are extracted
Btu drop is 1454.0 − 1295.5 = 158.5
Total Btu drop is 1454.0 − 992.3 = 461.7

1.0 − (158.5 ÷ 461.7) = 1 − 0.343 = 0.657, the factor

and 0.657 × 11,547 is 7,580 lb of steam added at throttle.

Example: At No. 1, 9372 lb are extracted; the drop is 368 Btu.

1.0 − (368 ÷ 461.7) = 1 − 0.797 = 0.203, the factor

and 0.203 × 9372 is 1902 lb of steam added at throttle.

NOTE the great difference in the quantities of steam required at throttle due to the location of the extraction points.

Calculations for Half-Load Heat Balance

Throttle flow, straight condensing ..... 80,794 lb per hr
Added at throttle, 2,731 + 1,424 + 1,409 + 642 ... 6,206 lb per hr
Total required at throttle ..... 87,000 lb per hr
Steam extracted, 4,741 + 3.414 + 4,588 + 2,559 .. 15,302 lb per hr
Exhaust steam to condenser ..... 71,698 lb per hr

Total flow is 87,000 + 270(glands) + 630(packing) .. 87,900 lb per hr

Enthalpy of steam at throttle ..... 1454.00 Btu/lb
Enthalpy of F.W. entering steam generator ..... 263.52 Btu/lb
Heat added by steam generator ..... 1190.48 Btu/lb

$$\text{Heat Rate is } \frac{1190.48 \times 87{,}900}{10{,}304} = 10{,}148 \text{ Btu/kw hr at HALF LOAD}$$

Enthalpy of steam at throttle ..... 1454.00 Btu/lb
Enthalpy of F.W. entering steam generator ..... 317.22 Btu/lb
Heat added by steam generator ..... 1136.78 Btu/lb

$$\text{Heat Rate is } \frac{1136.78 \times 175{,}000}{20{,}602} = 9{,}656 \text{ Btu/kw hr at FULL LOAD}$$

Calculations for Extraction Heaters

Heater No. 1 plus Cooler
Water out at 167.7 F or 135.7 Btu
Water in at 91.7 F or 59.7 Btu
difference 76.0 Btu per lb

155,764 × 76 = 11,838,000 Btu required

No. 1 Extr. is 9372 lb @ 1086 Btu

9372 × 1026.3 = 9,524,800 Btu available

No. 2 heater drain is 10,523 lb @ 205 Btu

10,523 × 145.3 = 1,423,800 Btu available

Gland leakage is 630 lb @ 1454 Btu

630 × 1394.3 = 872,100 Btu available
1,423,800
9,524,800
Total = 11,820,700 Btu available
11,838,000 Btu required

No. 1 extraction.. 9,372 lb
No. 2 heater drain 10,523 lb
Exhaust to cond... 134,969 lb
Gland leakage.. 630 lb
Make-up..... 270 lb
Condensate pump 155,764 lb

1086 − 59.7 = 1026.3 Btu

205 − 59.7 = 145.3 Btu

1454 − 59.7 = 1394.3 Btu

BALANCED

Check on DRAIN COOLER

Drain Cooler: 20,525(173 − 101.7) = 1,463,430 Btu

1,463,430/155,764 = 9.4 F rise on condensate

+ 91.7 F

Temp. of F.W. leaving cooler = 101.1 F

HEATER No. 2

Water out at 232.0 F or 200.25 Btu

Water in at 167.7 F or 135.60 Btu

difference 64.65 Btu per lb

155,764 × 64.65 = 10,070,150 Btu required

No. 2 extr. 1163 − 205.3 = 957.7 Btu per lb available

10,523 × 957.7 = 10,077,880 Btu available BALANCED

HEATER No. 3—DEAERATOR.

Water out at 283.9 F or 253.00 Btu

Water in at 232.0 F or 200.25 Btu

difference 52.75 Btu per lb

155,764 × 52.75 = 8,216,550 Btu required

No. 3 extr. is 1218.5 − 253.0 or 965.5 Btu per lb available

7,689 × 965.5 = 7,423,730 Btu available

Drain from No. 4 Heater is 350.8 F or 322.47 Btu

253.00 Btu

difference 69.47 Btu/lb

11,547 × 69.47 = 802,170 Btu available

+ 7,423,730 Btu available

Total = 8,225,900 Btu available

8,216,550 Btu required BALANCED

HEATER No. 4

Water out at 345.8 F or 317.22 Btu

Water in at 283.9 F or 253.00 Btu

difference 64.22 Btu per lb

175,000 × 64.22 = 11,238,500 Btu required

11,547 × 973.03 = 11,236,000 Btu available BALANCED

1295.5 − 322.47 = 973.03 Btu per lb

Questions and Answers

Your fellow engineers will answer your power plant questions. You answer theirs, get paid well. Simple? Effective? Why don't you try it?

Question No. 515

How Cut FW Heater Losses?

WE HAVE in our boiler room a Hoppes feed water heater which has been moved several times and is now back in our plant.

I know this heater at one time carried 2000 bhp on exhaust steam at 212F. At present it is only carrying 200 bhp. We are trying to keep the temperature at 212F and, as we have no exhaust steam, are using line steam. We are losing quite a bit through the exhaust head from the heater. We estimate about 15 per cent of steam produced is used to heat boiler feed water.

Would it be advisable to blow line steam directly into the water through a perforated pipe?

We might also have to keep some steam blowing over the water and trays. The heater has a safety valve and an automatic butterfly valve on it. We carry from 4 to 6 lb pressure on the heater.

In your opinion would there be any savings in steam by putting this perforated pipe under the water?

Canton, Ohio O. E.

Answer No. 507

Expansion Joints vs Expansion Loops

Installed Cost and Space Decide, Says C.W.P.

THE ECONOMICS of expansion joints vs expansion loops are fairly well governed by the initial cost installed, as maintenance is no longer a costly item on modern designs of corrugated expansion joints. The choice, however, is affected by physical considerations to the point that it is often necessary to choose the more expensive joint in order to conform to space limitations.

Underground, for example, or where pipes are carried in ducts or narrow tunnels, the expansion joint is sometimes indicated in preference to a loop, even though in the case of moderate temperatures and pressures the expansion joint is ordinarily more expensive.

Other things being equal, or where space limitations are not the controlling factor, we find the following general rules fit our local costs, where piping and fittings and fabricated bends are manufactured locally, but special expansion joints are imported at some extra cost.

1) For low temperatures and pressures, most piping layouts incorporate enough bends to take care of expansion without loops or special joints. Where this is not the case, put together a loop using extra-strong long-radius elbows.

2) For moderate temperatures and pressures below 200 psi, where space permits, an expansion loop made up of long-radius elbows is the cheapest, followed by a fabricated pipe loop and the bought-out expansion joint in that order.

3) For higher temperatures and pressures the fabricated loop and the expansion joint cost about the same as the installations are competitive. Each must be supported; however, in the case of the expansion joint where eccentricity exists it may be necessary to erect supports at considerable expense. On the other hand, the additional cost of insulating the expansion bend may determine the selection of a joint.

Since these other factors such as space limitations, supports and insulation cost must be taken into consideration in addition to the first cost of the loop or joint, and all factors vary with locality and type of job, it would seem necessary for P.R.O. to analyze his economics for the particular installation on the basis of local conditions.

Montreal, P. Q. C. W. P.

Answer to Question No. 510

What Is Wrong With This Engine?

Livingston Says Engine Underloaded, Eccentric Slipped, Valves Faulty

THE DATA supplied by O.H.D. is not as complete as I would like to have it, so I will assume the rest of it as follows: It is a one-cylinder Corliss, (seeing that it was built by Murray Iron Works), with a single eccentric, exhausting to process. How much of the back pressure is due to the process and how much to a too small exhaust pipe it is impossible to say.

An examination of the indicator cards leads to three main conclusions, as follows:

1. The engine is very much underloaded, as shown by the steam in the cylinder expanding to a pressure lower than that in the exhaust line. In other words, from the point when the lines cross to the end of the stroke, the cylinder is a vacuum pump, with the working load carried by the flywheel.

The only answer to this condition is to add more load, or replace with a smaller engine. This condition suggests that someone bought an oversized engine at a bargain, or else installed an engine that was on hand without first determining the power required to drive the beaters, and then selecting an engine suitable for the purpose.

2. The engine has a "slipped eccentric," as shown by the fact that the points of admission and release at both ends of the cylinder are late. The inlet valves do not open until the piston has passed center and started the working stroke. The engine for a brief period again acts as a vacuum pump, causing the pressure due to compression to drop. When admission does take place, the piston is on its working stroke, as shown by the slope of the line, and the valve is not fully open until the piston is still farther on its way, as shown by the point where the line of admission flattens off. The waviness of these lines indicates that the flow of steam is not smooth, due to the valves not seating properly, chattering, or leaking, as shown by the irregularities of the expansion line on the crank end.

The backward slope at the exhaust end shows that the valves are late in opening, as the backflow from the exhaust pipe does not raise the pressure in the cylinder equal to that of the exhaust until the piston has started on the exhaust stroke.

3. The height of one card measures $1^{5}/_{8}$ in., while the other is $1^{11}/_{16}$ in. This indicates a maximum cylinder pressure of 130-135 psig with a throttle pressure of 155 psig, which means a pressure drop of 20-25 psi between the upstream side of the throttle and the piston. This indicates that the inlet valves are not fully opening, or, what seems more likely, at some time in its history someone has replaced the original inlet valves with a pair from another Corliss engine of entirely different characteristics. It is evident that the valve-gear of this engine requires overhauling, and, possibly, new inlet valves.

HOWARD T. LIVINGSTON
Los Angeles, Calif.

Check Gages, Reset Valves—Van Huben

I KNOW nothing about "beaters" and paper mills, but I have been operating reciprocating engines for several years and believe I can give a reasonable analysis (within limits) of the cards shown. However, in doing so I assume that the reproductions are fairly accurate.

Based upon that assumption, I would suggest that Mr. O. H. D. check his gages as a first step. He says he has a throttle pressure of 155 psi, but the card shows only $1^{21}/_{32}$ in. above atmospheric line, which with an 80-lb spring would indicate only 133 psi. Also, by the same token, his back pressure is nearly 41 psi.

With no other data than is shown on the card, here is my analysis. I am referring to the crank end which is more definite but the conclusions apply to both ends equally:

1. Admission is too late and there is no lead. Shown by the admission line, leaning toward the direction of stroke and starting simultaneously with the stroke.

2. Cutoff is too early in stroke. Expansion line falls below back pressure line at approximately $^{2}/_{3}$ stroke, indicating an over-expansion of steam and no cushioning effect. The negative loop (below back pressure line) shows a loss of horsepower.

3. Release occurs exactly with end of stroke. If there were sufficient steam left in the cylinder at this point to have a pressure slightly above exhaust pressure, there would be a cushion providing protection against overriding of the piston as well as easing the shock of direction change, but the release should occur juts before end of stroke to prevent excessive cushioning.

4. The loop which appears below the line of maximum pressure shows that the compression reaches a maximum before the end of stroke and then falls off until the admission valve opens. This bears out the theory that insufficient volume of steam is being admitted and also seems to indicate that compression is out of adjustment. However, I suggest that the admission and cut-off point be corrected and further cards taken before changing the setting of the exhaust valves. It may be that such correction will also correct the release and compression indications.

I believe that if O. H. D. follows these suggestions, he will get a better card from a more efficient engine.

I have not tried to figure the horsepower developed since the card shows the valves definitely out of adjustment.

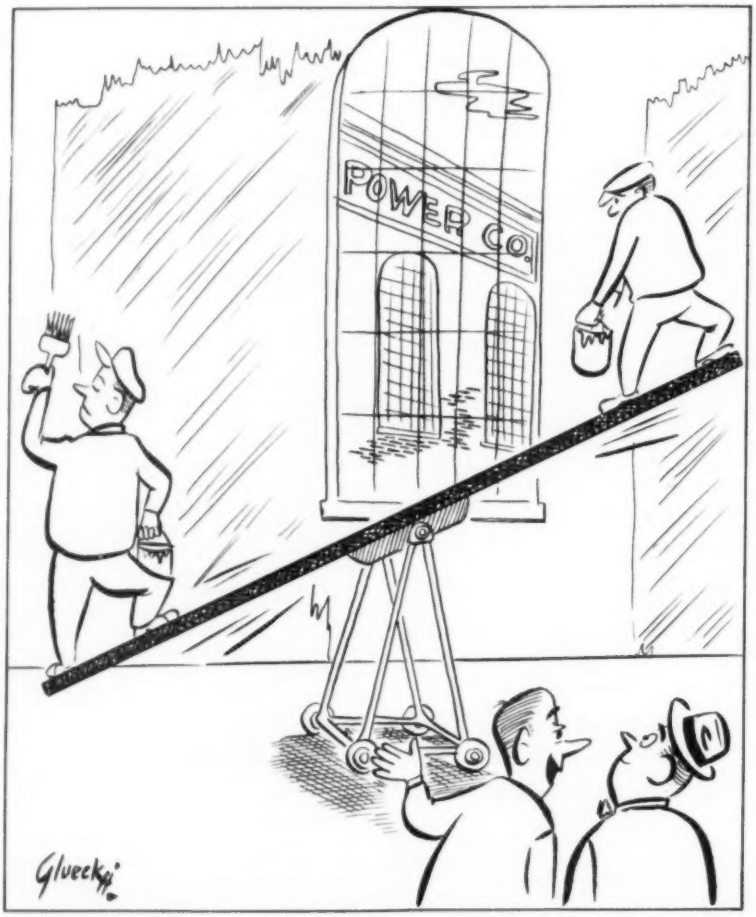
LEWIS C. VAN HUBEN
Orangeburg, N. Y.

Smith's Answer

IN LOOKING at O.H.D.'s cards, late steam admission is shown on both the head and crank ends which apparently would show that some attention must be given the adjustment of the admission valves. Card also shows a very short cut-off, which could produce the loop on the exhaust end of card. The loops on the admission ends of both cards apparently are produced by late admission accompanied by high compression.

I would advise O.H.D. to check angular advance of eccentric first. If this is found to be all right, then make valve adjustments, taking a set of cards after each change in order to see if any improvement has been accomplished.

O.H.D. has not stated whether his engine is a single-valve, or four-



"Gave us a little trouble at first, then Joe brought in some Mothersill's Sea-Sickness Remedy"

valve type. However, adjustments are usually more easily made on a four-valve engine in some cases.

Roughly figuring from one of the cards, the MEP (mean effective pressure) is about 16.5 psi, which would in turn figure out to about 380 hp based on PLAN P = 16.5 – L = 4 ft – A = 511 (after deducting for area of piston and tail rods) – N = 2 by 93 = 186 giving $\frac{16.5 \times 4 \times 511 \times 186}{33000}$ = 190 HP for one end × 2 = 380 hp. However, the MEP. appears to be quite low for the 33 psi back pressure. If O.H.D. will try a little lighter spring, perhaps he can get a larger size card which may help simplify his valve adjustments.

ELLIOTT E. SMITH
Clark's Summit, Pa.

Back Pressure Keeps Engine Running, Says Ippen

MR. O.H.D. does not say much about this engine; that is, whether single or double eccentric or the type of governor.

These diagrams show this engine to be late in admission of steam at both ends of stroke. That is about all that is wrong. If this engine has two eccentrics, move the steam eccentric ahead about $\frac{1}{4}$ in. to get about $\frac{1}{16}$ in. lead at beginning of stroke; or if this engine has wrist plates, shorten the reach rods to admit steam a little earlier.

He may have to lengthen dashpot rods to be sure the valves open. This should be done with engine running slow. It is my opinion that if Mr. O.H.D. does either of the above, his engine will run satisfactorily, as the compression seems to be satisfactory. I am of the opinion that is about all he will have to do. The 33 psi back pressure is about all that keeps this engine running. If he had a vacuum this engine would pound badly.

I have 40 years experience at running engines in a paper mill and can see his problems. It does not make any difference how many years you have to your credit, however. A look at a book will help in some cases.

If Mr. O.H.D. will get a copy of Audel's, "Engineers' and Mechanics' Guide", and take Guide #3 and turn to page 1287, he can see what is wrong. If he will give these drawings careful consideration, he will not have this trouble any more. Hoping this will help Mr. O.H.D.

Terre Haute, Ind. AUGUST IPPEN

Editor's Note: *It is unfortunate that we cannot print all the replies to Question No. 510, which practically amounted to a census of reciprocating steam engine users — past and present. Many of your letters asked to see indicator cards of O.H.D.'s engine after he made the adjustments suggested. We will attempt to do this and give a summary of things he tried. Incidentally, some of you can really wring the information out of an indicator card.*

Answer to Question No. 511

What Causes Water Hammer In This Tail-Pipe?

Avant Says Air from Chilled Water Does It

THE WATER hammer is caused by air that is being pushed into the condenser from the water that is being chilled. At 29.75 in. Hg vacuum, water is standing approximately 33.73 ft from hot well level up in the vertical tail pipe. These slugs of air are being carried down into the tail pipe where they are compressed in one huge bubble. Suddenly there is an explosion of bubble and air and water flow out into hot well.

Mr. E.E.M. should install an air pump in the 6-in. vent line for the removal of this trapped air. I feel that if the trapped air is removed from top of condenser there will be no more water hammer.

I have operated barometric condensers in years gone by. During periods of light loads we could operate without the air removal pump with approximately 1 in. Hg loss in vacuum, but on heavy loads the vacuum went down considerably until the air removal pump was put into operation.

GEORGE G. AVANT
Wilmington, N. C.

"Mr. Smudge called to say he considers your memo concerning his cigars to be your resignation and he accepts it."

Check Hydraulic Flow Through Tee — Brooks

THE FOLLOWING information would be helpful in analyzing this problem: 1. What is the tail water temperature when hammer starts at 27.8 in. vacuum? 2. What is the tail pipe velocity when hammer occurs? 3. Is hammer a function of water velocity in the tail pipe, or condenser vacuum? That is, will hammer occur at light load when the vacuum and temperature are the same as above with the full water quantity flowing?

Despite the need for the above information, I will hazard an analysis and possible solution.

I believe hammer is primarily a function of tail pipe velocity and secondarily tail water temperature. At the critical velocity at or above which hammer occurs, water vapor is entrained by the water flowing through the 14-in. tee. In the tail pipe below the tee, the water vapor collects as slugs and is condensed. The condensing or collapsing of these slugs creates voids which are filled by the water. Water rushing into the void comes to an abrupt halt when it is filled, thereby causing water hammer.

I suggest they install a piece of plate glass across the top of the 14-in. tee and observe the hydraulics in the tee, with and without hammer. This may suggest an obvious solution. The plate glass does not have to be bolted — just place it on a rubber gasket. Forget the vent while observing flow patterns.

Possibly a self-venting baffle in the tail pipe would stop the hammer. I suggest that this be made up of three $\frac{1}{4}$-in. steel plates, joined together along the centerline of the pipe and radiating outward from the joint with equal angles between. Suspend the baffle from the cover plate on top the tee. One leg of the baffle should be in line with the 16-in. pipe and about $\frac{1}{4}$ in. clearance should be provided between the three legs and the pipe wall. Length may vary from 2 to possibly 15 ft, depending on flow pattern observed.

AARON D. BROOKS
Midland, Michigan

Free Fall Down Tail-Pipe, Says Shenk

THE FOLLOWING thoughts on question 511 are not tested. The free fall of the water in the 14-in. vertical pipe is greater than necessary. The velocity of the water is low at the top of this pipe but increases rapidly with the fall. For this reason the water does not fill the pipe at the lower end. Probably the tail pipe is not more than one-half full at the 90 deg elbows. It is doubtful that the pressure in the pipe ever gets as high as atmospheric in the vertical pipe. An implosion probably takes place at the point where the speed of the falling water is checked. That is at the 90 deg elbow. This trouble should be eased either by reducing the pipe size to fit the stream at the lower end or by restricting the outflow enough to raise the effective altitude of the hot well.

Perhaps this may help E.E.M.

Huntsville, Ala. D. H. SHENK

PLEASE

When submitting questions or answers, be sure that your return address is given. If this is not done, we can neither publish your letter nor make proper payment.

PRACTICAL HINTS AND KINKS

How about the gadget you made or the trick you used to do your job better? Write us about it. Send a sketch too. You will be paid well for contributions.

Handy Gadget for Wire Coding

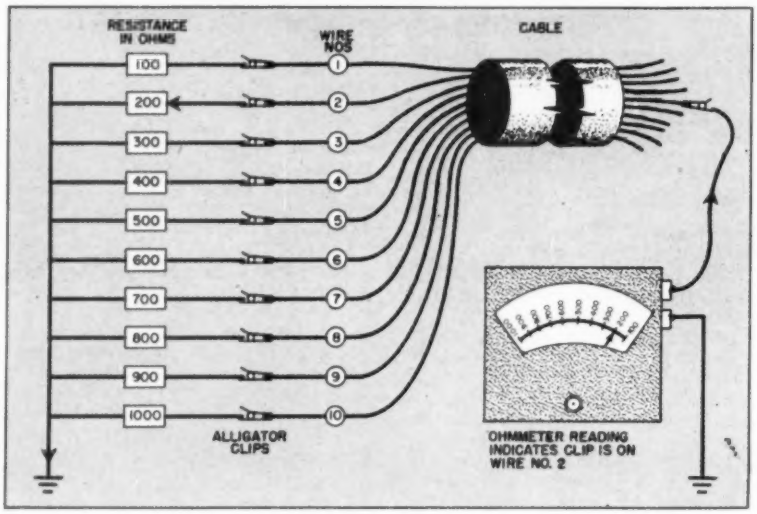
By L. W. FITZPATRICK

NUMEROUS SCHEMES for identifying wires in motor circuits have been worked out over the years, but most are inadequate when more than four wires are to be checked. Also, they require more than one man or considerable running back and forth to check out each wire.

A handy and simple gadget which one man can use — and without commuting from one end of the cable to the other — can be made up of alligator clips, resistors and an ohmmeter. Suitable resistors, such as those shown in the diagram, are connected to a common ground at one end and to alligator clips at the other. Clip the resistors to the individual wires at one end of the cable, taking care to connect the 100-ohm resistor to wire No. 1, the 200-ohm resistor to wire No. 2, and so on.

At the other end of the cable, ground one lead from an ohmmeter and attach an alligator clip to the other. When this clip is attached to one of the wires in the cable, the ohmmeter (powered by its own battery) will show a resistance reading slightly higher than that of one of the resistors at the other end of the cable. A reading of about 200 ohms would indicate that the ohmmeter is connected to wire No. 2, 500 ohms that it is connected to wire No. 5, etc.

This low-cost helper will save much time, annoyance, and an additional helper and telephones when wires are checked out.



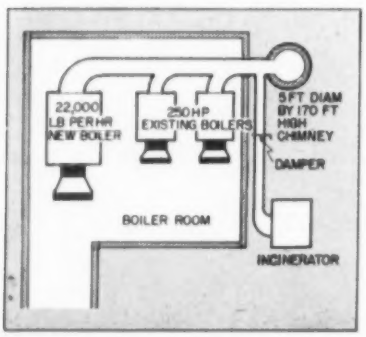
One of the simplest of the many multi-wire checkers, this device consists of resistors, ohmmeter and clips

Cases in Smoke Abatement

Cincinnati Hospital Gives Up Smoking

By CHARLES GRUBER
Chief Smoke Inspector
City of Cincinnati

A 319 HP (22,000 lb per hr output), 3-drum Stirling boiler was installed in an existing hospital boiler room. The new boiler was added to two existing 250 hp water tube boilers, to be used alternately with the battery of existing boilers. No structural changes to the building were required. A 5-ft diam by 170-ft-high chimney was available, and was considered adequate.



Hospital boiler room which nearly "smoke-cured" Cincinnati. Thirty trips by smoke inspectors to the plant and a year and a half of buck passing were required to find and correct source of smoke

When the new boiler was put on the line, it was found that the boiler design capacity could not be reached without rodding the stoker fire. The results of the rodding were very dense smoke, which brought the smoke inspector on the job. First the coal was blamed for the trouble. The coal was then "hand-picked" but no improvement was noted. Then the stoker man and boiler man were called on the job. The baffling of the boiler was checked but was found to be satisfactory. The stoker forced draft fan was then speeded up. The firebox temperatures became excessive.

Further investigation revealed that there was 0.3 in. draft loss between the base of the stack and the new boiler. It was found that in addition to the two existing boilers an incinerator was connected to the breeching.

A tight incinerator damper was installed and the dampers of the two "dead" boilers were refitted. The draft on the new boiler became ample, but the smoke continued. The forced draft fan was again increased, and a separate motor drive installed. After this last change was made, the smoke was eliminated, the load easily carried, and excessive temperatures in the furnace were eliminated. The job was then okayed.

For the Cincinnati Smoke Inspection Bureau, the case was opened on June 11, 1948, and was considered closed more than a year and a half later (January 16, 1950), after more than 30 trips to the plant by the BSI staff, answering dozens of citizens' complaints of smoke, much "passing of the ball" between the coal supplier, the stoker contractors, the operating crew and the designing engineer. Since January 1950, there have been no more violations.

The lessons to be learned from this job are that "dead" equipment can materially affect stack draft unless it is thoroughly sealed by tight dampers, and the lack of flexibility of stoker control and undersized forced draft fan with no over-fire air to handle unusual situations can cause serious operating difficulties resulting in dense smoke.

Protecting Cables From Heat

By W. E. WARNER

CABLES CAN be protected from external heat by painting them with some heat resisting insulating varnish, and when this dries just to a tacky state, it should be sprinkled with some finely powdered old boiler lagging. As the paint dries the cables will be lagged effectively.

Where cables are protected by conduit this can be lagged by painting it with black paint and, before it dries, sprinkling it with boiler lagging.

WHY BE STYMIED BY CARRYOVER and BLOWDOWN?

Impure steam and excessive blowdown are two problems that need not be tolerated by any power plant engineer, thanks to effective anti-foam agents.

Within recent years, the Betz organization has developed several anti-foam agents which have produced remarkable results both from a standpoint of better boiler operation as well as direct savings.

For instance, a southern chemical plant installed a new high pressure boiler and turbine to operate in conjunction with the existing lower pressure boilers and turbines. To minimize silica vaporization, the condensate of all boilers was returned to the high pressure system. As a result, difficulties were encountered in the operation of the low pressure system—high boiler water solids developed causing severe carryover, and the low pressure turbines eroded seriously.

After analysis, Betz Engineers recommended the application of anti-foam agents which *immediately* remedied this carryover condition. The solids content of the steam was reduced to 2 ppm at high boiler ratings without any increase in blowdown.

The positive control of carryover and boiler blowdown is just *one* of the *many* services offered by the Betz Organization. Let a Betz Engineer explain to you how our *complete* engineering guidance can help you solve all your water problems. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

For the complete story on carryover and blowdown control through the use of anti-foam agents, write for Technical Paper No. 115.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

For more data circle 550 on Post Card

Diagnosis and Cure of "Sulphated" Batteries

A "SULPHATED" battery is one which has been undercharged to the point where abnormal lead sulphate has formed on the plates. When this occurs the chemical reactions within the battery are impeded and loss of capacity and complete failure may result. Gould-National Batteries, Incorporated suggests an eleven point program to "cure" a sulphated battery plus six causes of sulphation which should be avoided.

It is important to detect a sulphated battery as soon as possible. The sooner treatment is started, the less the damage from sulphation will be and the earlier the battery can be returned to service.

Here's how you can diagnose a sulphated condition. All cells of a sulphated battery will give low specific gravity and voltage readings. An internal inspection will disclose that the negative plates have a slate-like feeling, sulphated negative-plate material being hard and gritty and having a sandy feeling when rubbed between thumb and forefinger. The internal inspection should be made after a normal charge since a discharged plate is always somewhat sulphated. A normal fully charged negative plate is spongy and springy to the touch and gives a metallic sheen when stroked with the fingernail or a knife. A sulphated positive plate is lighter brown in color than the normal plate.

Most cases of sulphation are caused by the following:

1. **Undercharging, partial charging, or neglect of equalizing charge.**

When a battery is charged repeatedly at low rates the acid is not effectively driven out of the plates, particularly the lower parts, and sulphation results. Repeated partial charges, stopping before there has been sufficient gassing to effect a thorough mixing of the electrolyte, results in sulphation. It is difficult in normal battery operation to determine just when sulphation begins, and only by giving periodic equalizing charges and comparing individual cell specific gravity and voltage readings can it be detected in its early stages and corrected or prevented.

2. **Standing in a partially or completely discharged condition.**

Permitting a battery to stand in a partially discharged condition allows the sulphate deposited on the plates to harden and the pores to close. Batteries should be charged as soon as practicable after discharge and not allowed to stand in a completely discharged condition for more than 24 hours.

3. **Low electrolyte.**

If the level of the electrolyte is permitted to fall below the tops of the plates, the exposed surfaces will harden and become sulphated.

4. **Adding acid.**

If acid is added to a cell in which sulphation exists, the condition will be aggravated.

5. **High specific gravity.**

In general, the higher the fully charged specific gravity of a cell, the more likely is sulphation to occur and the more difficult to reduce. If, in any battery, there exist cells of which the specific gravity is more than 0.015 above the average, the possibility of sulphation of these cells will be increased.

6. **High temperature.**

High temperatures accelerate sulphation, particularly of an idle, partially discharged battery.

Tc Restore Battery

Thorough and careful attention to the following steps often will restore a sulphated battery to good operating condition:

1. Clean the battery.
2. Bring electrolyte level to proper height by adding *water*.
3. Put battery on charge at the prescribed finishing rate until full ampere hour capacity has been put into the battery based on the 8-hour rate. If at any time during these procedures the temperature of the battery exceeds 110F, reduce the charge rate to maintain temperature at or below this point. If any cell gives low readings (voltage 0.2 v less than the average cell voltage of the battery), remove and repair the cell before continuing with the procedure.
4. Continue the charge at the finishing rate until the specific gravity shows no change for a 4-hour period with readings being taken hourly. Record voltage and specific gravity readings. Correct specific gravity readings for temperature. These readings indicate the state of charge of the battery.
5. Place battery on discharge at the 8-hour rate and during the test record individual cell voltages and overall battery voltage at the following time intervals: 15 minutes after test is started, then hourly until voltage on one cell

(Continued on page 160)

Sulphated negative plate (shown) has slate-like feel and, in this case at least, slate appearance

"Brilliant repartee, Boss, but it's obvious you ain't never met the president of the company."

"What say we pass that sledge around once more and then one of you knuckleheads start using it."

Check *American* Quality—Feature by Feature—and you'll know

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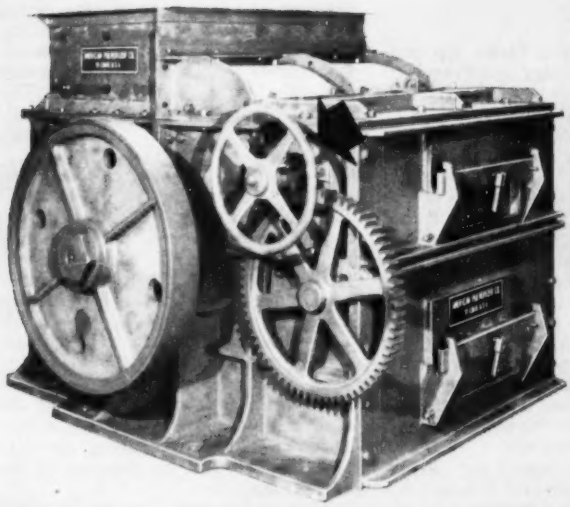
per ton



1 EASY ACCESS TO ADJUSTMENTS. Constant improvements in design over the years has produced a crusher with all adjustments *external*—and adjustable *while the crusher is in operation.*

AMERICAN Feature No. 4

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For more data circle 551 on Post Card

Use Your Lathe to Cut Large Gaskets and Trim Washers

By F. E. RILEY

IN OUR MAINTENANCE SHOP we often have to make large diameter gaskets and washers from non-metallic materials. When cutting out such gaskets using a standard washer cutter in a hand brace, we have found that the large diameter offers little support to the ring when the cutters are penetrating through the material, with the result that the ring is torn and damaged and has a very ragged edge. We have stopped using the brace-operated washer cutter for non-metallic materials, and have adopted the idea shown in Fig. 1. It works very well, and gives a cleaner and more accurate cut.

A soft wooden board is secured to the face plate of a small lathe, and is held in place by wood screws at the back of the plate. The square of gasket material to be cut is easily stuck on the wooden front plate with four common thumb tacks.

A cutting tool is made up by holding an ordinary razor blade in a wooden holder. A narrow saw cut is made in the end of a piece of hardwood to take the blade which is held at an angle of about 45 deg to the face of the work with the cutting edge upwards. The slot in the wood grips the blade by means of a small bolt which passes through a hole drilled in the holder and intersecting one of the holes in the razor blade. The position of the blade tip protuding from the holder is arranged to be at the lathe center height when mounted in the tool holder.

It will be apparent that if the wooden disk to which gasket material is secured is revolved and the saddle of the lathe is traversed, the blade tip cuts into the material and cuts a neat circle. The center hole of the annular gasket should be cut first and the diameters of the circles required are set as follows: The center point in the lathe tailstock is slid up to the work so that it makes a mark in the material to show the axis. A rule laid on the face of the material enables the distance from the center to the blade edge to be set by adjusting the lathe cross slide.

With the work revolving slowly, the blade tip is pushed through the gasket material and cuts out a neat circle in about one second. A razor blade is so thin and sharp that very narrow rings in thin gasket material can be cut without distortion.

Trimming Solid Center Disks

Another job that often gives trouble is reducing the diameters of stock washers, and turning, to accurate diameters, the edges of small metal disks that have no central holes. These solid disks often are used to blank off pump connections for testing, and we have found that they must be truly circular if trouble is to be avoided. We usually saw the disks out of a thick copper sheet, trim the corners roughly with a file, and then turn the edges in a lathe, using the equipment shown in Fig. 2.

The "blind" disk is sandwiched between the flat ends of two pieces of steel bar so that the lathe cutting tool can work on its outer diameter. One bar is center-drilled at one end and faced square at the other. The second piece of bar is gripped in the headstock chuck and is faced truly in position.

A disk to be turned is placed between the two bar ends, as shown in the illustration, and the tailstock center is pushed up to hold the complete assembly lightly together. With the lathe revolving, the disk can be made to run fairly concentrically by tapping its periphery as it revolves. When it is running centrally enough, the tailstock center is pressed up with greater force so that the frictional grip of the bar ends on the disk is increased. By taking a succession of light cuts along the disk periphery, it can be reduced to the desired diameter.

If a ball-bearing center is available for fitting to the tailstock the frictional resistance to turning will be reduced and heavy cuts can be taken. If the metal disk is bent or distorted the frictional hold will be reduced and the drive will be poor. We overcame this difficulty by folding a small piece of emery cloth double, to form a small square with the abrasive sides outward. This is sandwiched between the disk and the face of the bar held in the chuck, and forms a rough frictional drive.

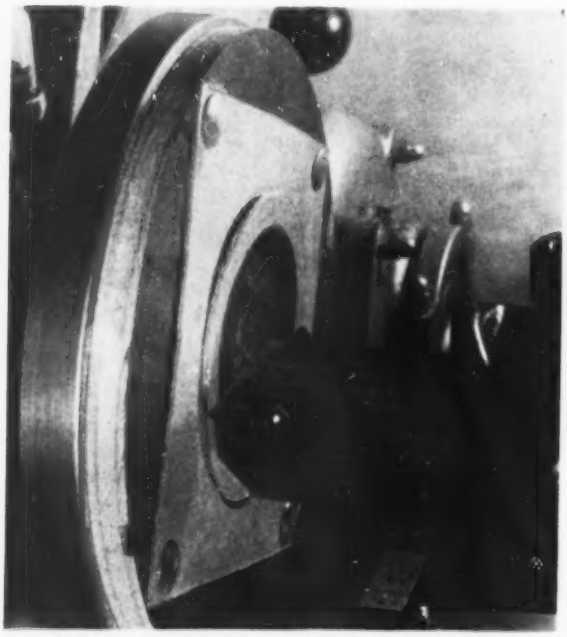
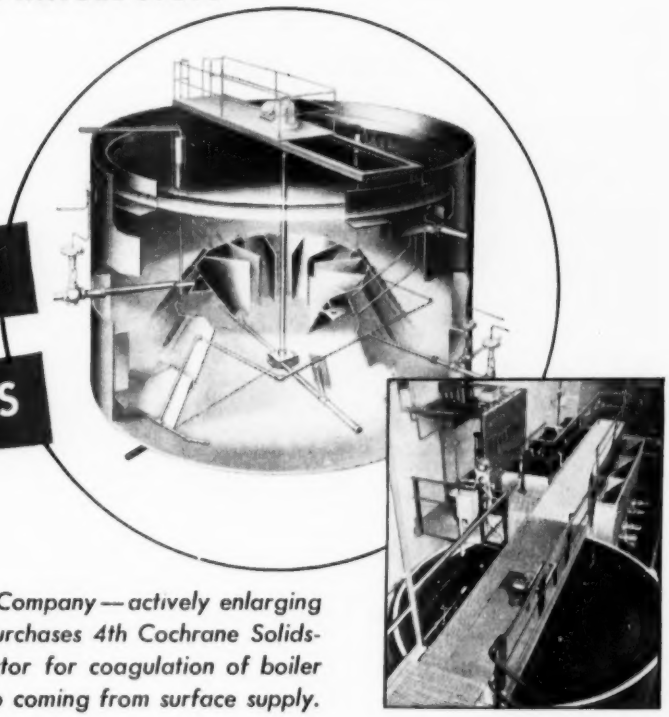


Fig. 1. Cutting a large gasket ring on a lathe using a razor blade for a tool

Fig. 2. The thin metal disk is held in place by pressure while being turned

COCHRANE WATER CONDITIONING
STARTS WHERE NATURE STOPS

REPEAT ORDERS FOR COCHRANE REACTORS



Duke Power Company — actively enlarging capacity — purchases 4th Cochrane Solids-Contact Reactor for coagulation of boiler feed make-up coming from surface supply.

• This record of repeat orders is evidence of successful design and performance. Units are being built for coagulation, lime softening, iron removal, fluoride removal, white water recovery in paper mills, cooling water treatment, process water clarification, tin plate rinse water, oil field flooding water and similar applications.

They can be built in small sizes—such as for the bottling trade, or in very large sizes—such as for paper mills, up to 110′0″ dia., capable of handling more than 20,000,000 GPD in a single unit.

Write for new Solids-Contact Reactor Catalog—Publication 5001-A —just off the press.

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cochrane

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In Europe: Recuperation Thermique & Epuration, Paris
In Cuba: Laurence E. Daniel, Inc., Havana
In South America: Servicios Electricos, C.A. (S.E.C.A.) Caracas, Venezuela
In Puerto Rico: F. A. Ortiz & Co., San Juan 5

Hot Process Softeners • Deaerators • Dealkalizers • Demineralizers • Reactors • Continuous Blow-Off • Specialties • C-B Systems

For more data circle 552 on Post Card

New Design for Reciprocating Steam Engine

Improved design featured in this new reciprocating steam engine promises good efficiency, easy access for maintenance, a rugged construction, and full reverse power. It also proves that reciprocating steam engines will be here for some time to come

NEW DESIGN features for the steeple-compound unaflow single-acting Woolf Cycle steam engine were announced recently by the Skinner Engine Co. of Erie, Pa. To many of us, this pronouncement could be the first time we ever encountered the jaw-breaking title. This is because the steeple-compound engine (to abbreviate) has seen its greatest application in the marine field. It is a very interesting cycle, however, and one with which power engineers should be familiar.

Single-Acting Cycle

The "single-acting" characteristic is made apparent by examination of the cross-section view. The smaller (high pressure) piston delivers power only on the "up" stroke. At the top of its stroke, the piston uncovers ports in the h-p cylinder liner and the steam is by-passed around the h-p piston to its top side and into the annular space that surrounds the liner.

At this point in the cycle, the transfer valve opens and the h-p steam passes through the cylinder head to the top of the l-p cylinder. The l-p piston delivers power only on the down-stroke. When the transfer valve closes, steam remaining in the h-p cylinder is trapped and compressed to the initial pressure. Steam in the l-p cylinder continues to expand until the piston uncovers the large unaflow exhaust ports. When the up-stroke starts, another valve in the cylinder head opens and steam above the l-p piston vents to the condenser to relieve compression. This is especially helpful in starting and, in marine applications, maneuvering.

Cylinder Cooling

Low-pressure steam in the annular space around the h-p cylinder acts as a coolant and reduces the liner temperature to a point where lubrication is accomplished readily. The piston rod steam packing in the cylinder head also is surrounded by an annular chamber filled with l-p steam which cools the packing rings and prevents carbonization of lubricating oil. This steam packing is never exposed to air, thus improving its resistance to carbonization.

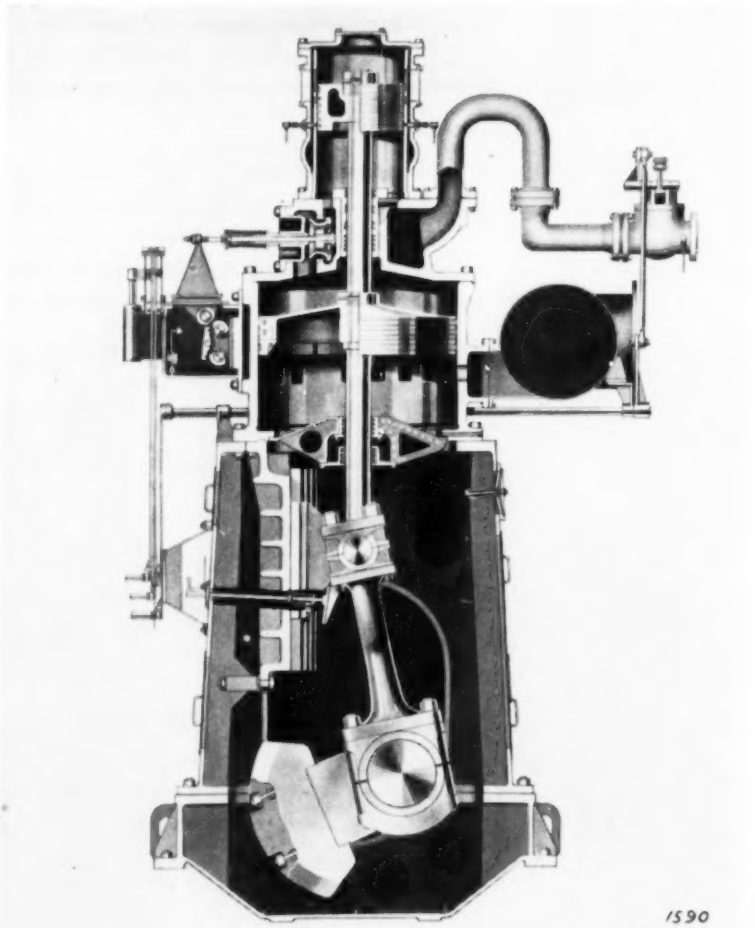
Access for Maintenance

One of the major faults of the steeple-compound engine has been the lack of accessibility of the l-p cylinder for maintenance. The new design (see illustration) overcomes this fault by making the l-p parts accessible through the crankcase. After removal of the bottom cover, which is split and light-weight for that purpose, the l-p piston rings can be replaced through the crankcase without disturbing the piston or any of the superstructure. Vacuum packing and wiper packing also are accessible in this manner.

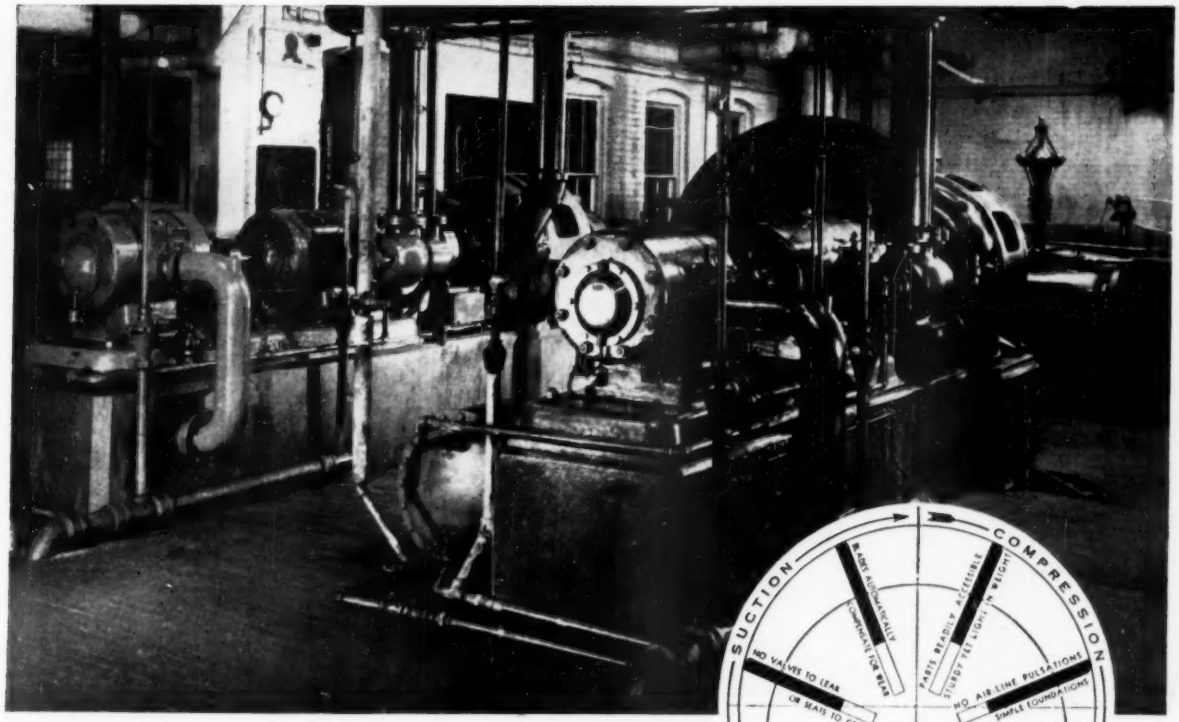
Dual Lubrication

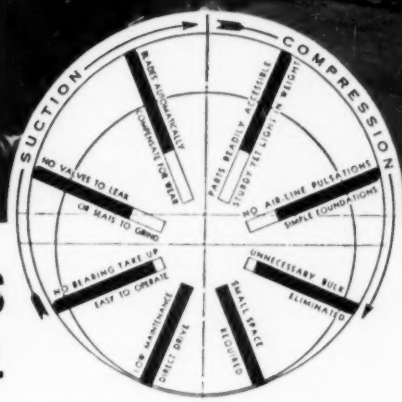
Lubrication is accomplished in two ways: (a) direct injection at two points in the h-p cylinder liner, and (b) conventional injection at the throttle valve. Reduced waste through vaporization is achieved in this manner. The h-p cylinder liner is steel, electroplated with porous chrome to provide an oil-retaining surface of great hardness and wear resistance. Copper-lead bearing metal rings are permanently fitted to the pistons to burnish the cylinder wall and prevent contact with the piston body.

A total of eight 4000-hp units of this design has been purchased so far for marine use. Each contained four cranks and four sets of compound cylinders, but any number of cranks can be combined since each element is independent and has optimum balance of inertia forces.



Uniflow principle is applied to this steeple-compound engine. Any number of these cylinder-crank elements can be combined to form a single engine since each element is individually dynamically balanced





FULLER ROTARY AIR COMPRESSORS . . . WORK FOR SCOVILL

Long periods of continuous operation don't overtax these Fuller Rotary Compressors at Oakville Company Division, Scovill Manufacturing Company plant at Oakville, Connecticut, where two 850 c.f.m. two-stage compressors supply plant needs at 80-lb. pressure.

Endurance, plus maintained efficiency, are results of the rotary principle employed in these compressors. Elimination of reciprocating parts does away with flow pulsations, cuts down on vibration and need for take-up of bearings. Another feature of interest to cost-conscious engineers is the limited maintenance required by Fuller Rotary Compressors—rotor, blades, and bearings are the only moving parts.

Because these compressors do not require valves, top overall efficiency is maintained at all times—no capacity is lost around leaking valves, no time lost to grind seats. Fuller compressors are designed to operate at common electric motor and internal-combustion engine speeds.

You'll find these compressors stay on the job, operate with sustained high efficiency and require little maintenance. If your plant requires air in volume, it will pay you to investigate the advantages of Fuller Rotary Compressors. A Fuller engineer will be glad to discuss them with you.

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FULLER COMPANY, Catasauqua, Pa.

Branch offices

Chicago—San Francisco—Los Angeles—Seattle—Birmingham

C-223
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PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS

For more data circle 553 on Post Card

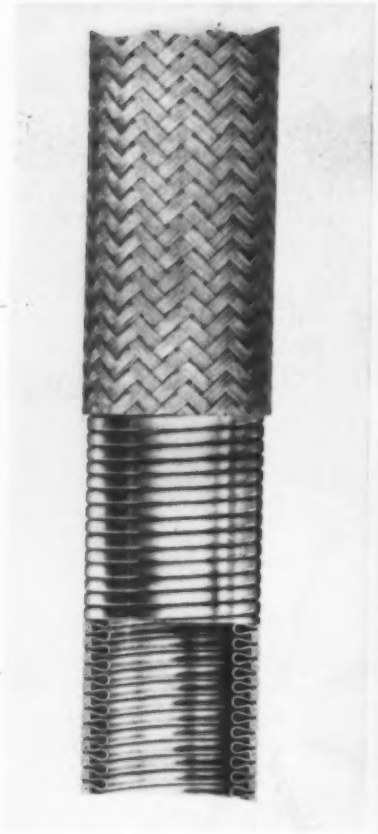

Fig. 1. Cutaway of watercooled flexible conductor showing inner brass tube and outer copper braid

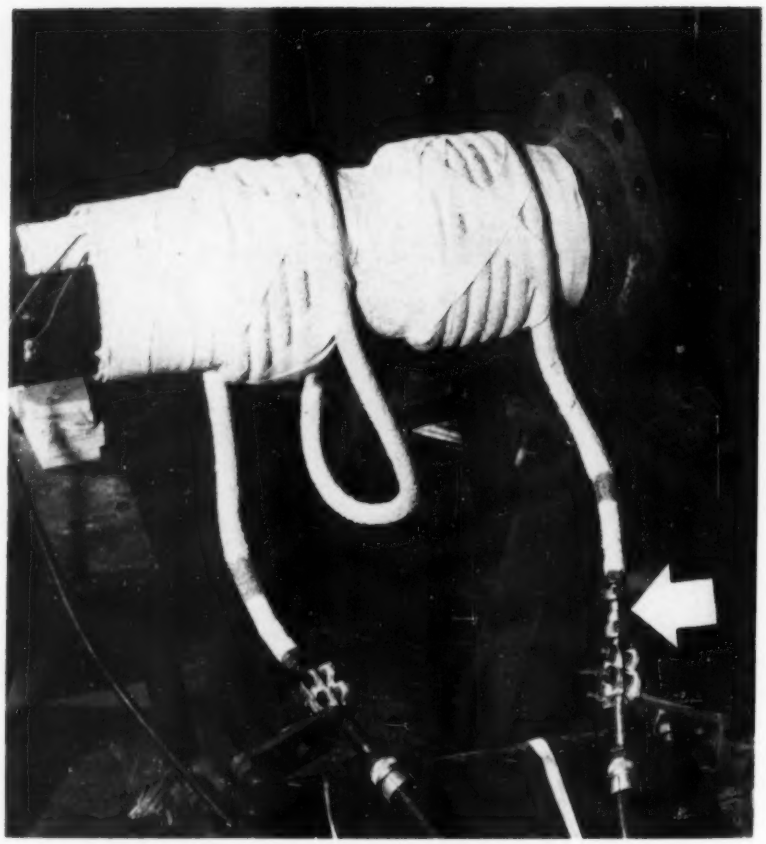

Fig. 2. Asbestos-covered flexible conductor being used for stress relieving pipe by induction heating. Arrow shows fuse link that cuts off current to prevent the conductors burning if water supply should fail

Watercooled Flexible Conductor Solves Induction Heating Problem

LOW FREQUENCY INDUCTION heating is used widely for preheating, stress relieving and annealing alloy steel welds subject to high stresses and temperatures. With the Smith-Dolan system, used by Electric Arc, Inc., the piece of metal to be heat treated first is wrapped with asbestos paper and over this is wound several turns of coil encased in asbestos tubing. Alternating current of about 1000 amps is passed through the coil and the resulting induction effect generates heat within the metal being treated.

The heat generated in the metal depends, among other things, on the number of layers of coil wound round the metal. One layer is enough for temperatures up to 1400 F, but above this it would be necessary to pile two or even three layers. When more than one layer is wound round the work, the combined heat of the outer layers and the heat of the work itself tends to burn out the inner layer of coil. This trouble caused the firm to search for a conductor that would carry the heavy current and yet remain cool enough to allow several layers to be wound round the work.

Titeflex, Inc., developed a water cooled metallic conductor that solved this problem. Ordinary copper tubing would not do as the continual bending made it work-harden and break, so they made their tubing in two parts: an inner $\frac{3}{16}$ in. diam brass tube to carry cooling water at a rate of 3 gal per min, and an outer tube of flexible copper braid to carry the current. Figure 1 shows this conductor being used for the stress relief of a large pipe weld. The arrow points to a special fuse link that cuts off current and prevents the conductor burning if the water supply should fail.

With these watercooled conductors the asbestos covering round the coils does not deteriorate from excessive heat and does not have to be replaced. Though this new conductor is used mostly in power piping manufacture at present, it can be used to advantage in any situation where space for heating is limited, and it has been used successfully in constructing the new atomic powered submarine.

The same firm also produces flexible watercooled high frequency conductors for brazing, soldering and welding and for dielectric heating. They are made with a brass inner core braided with fine copper wire for minimum power loss and covered with molded polyethylene or asbestos for thermal and electrical insulation. Their flexibility gives them a much longer life than conventional copper tubing that work-hardens and cracks.

ALL FORGED STEEL

Edward

INSTRUMENT VALVES

Lowest Cost Valves for Their Rating!

Standardize on Edward instrument valves—forged steel, yet their price is comparable to ordinary bar-stock valves.

Edward instrument valves are top quality in every design detail—easy-grip T-handle . . . bronze yoke bushing . . . forged steel one-piece outside screw yoke . . . forged steel corrosion-resistant EValized packing gland . . . EValloy 13% chromium stainless steel stem-disk with needle point for close flow control . . . forged steel EValized gland bolts that swing out of the way for easy repacking . . . heat resistant die molded EValpak packing.

And look at this versatility—

★ **STEAM, WATER, OIL or GAS PRODUCT PROCESS LINES**

Edward instrument valves fit into any piping system. Globe or angle, sizes ¼", ⅜", ½", ¾" and 1".

★ **HIGH TEMPERATURES or HIGH PRESSURES**

Rated up to 6000 lb at atmospheric temperatures, or up to 1500 lb at 1000 F.

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Orifice Meters	Regulators
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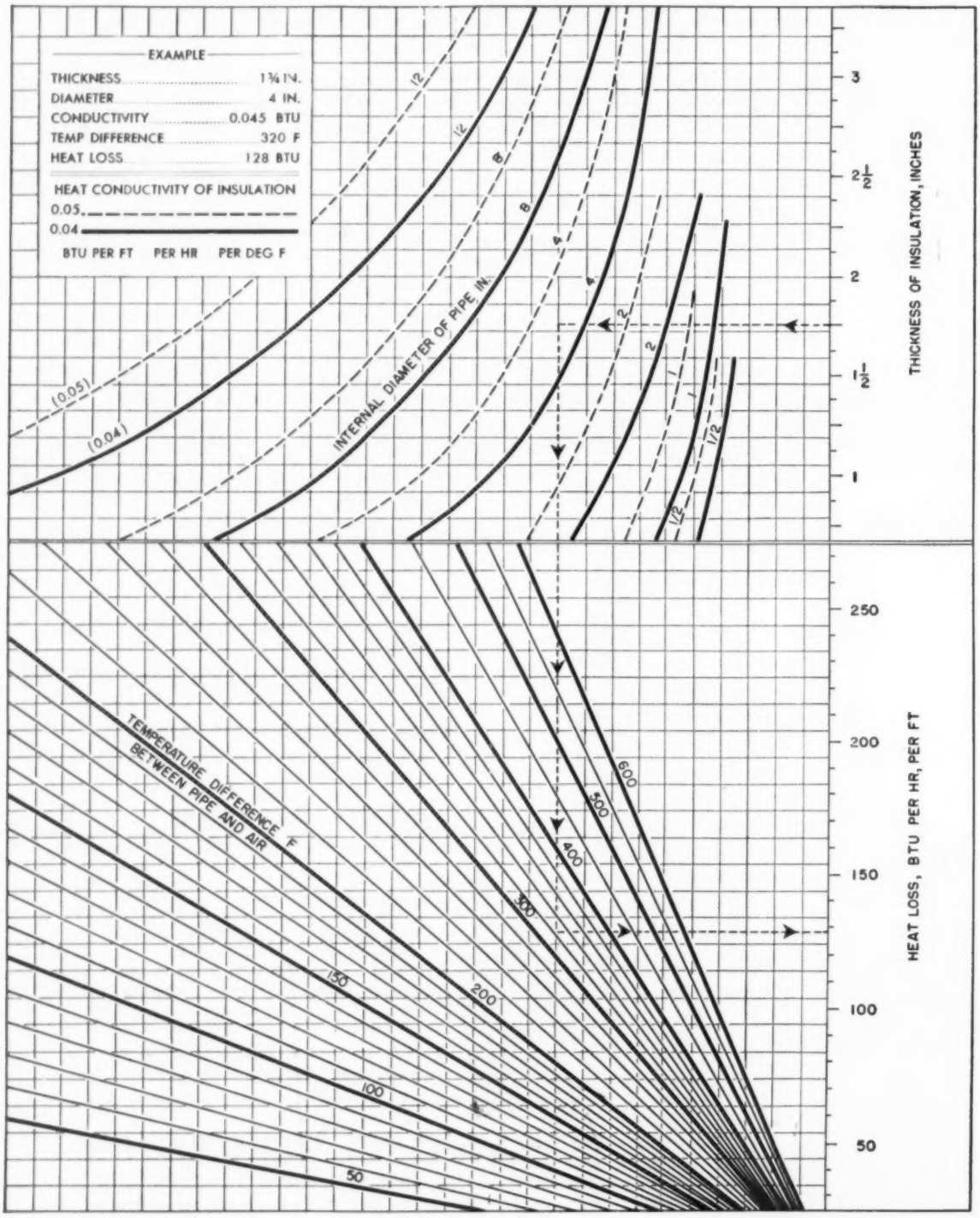
Another Product

Curves for Figuring Heat Losses from Insulated Pipelines

Use this chart with "Curves for Figuring Heat Losses from Uninsulated Pipelines" (September issue of POWER ENGINEERING) to determine savings effected by insulating pipelines. Approximate solutions for conductivities above, below, or between 0.04 and 0.05 are obtained by interpolation or extrapolation



Courtesy *The Steam Engineer*, London, England. Copyright in Great Britain by W. Goldstern.

VULCAN at WABASH RIVER STATION

PUBLIC SERVICE COMPANY of INDIANA, INC.

ADD Wabash River to the rapidly growing list of utility stations entrusting to VULCAN the important job of boiler cleaning. This Vulcan System includes long retractables, rotary units and air-heater cleaner controls—each designed for a specific cleaning job. They clean effectively at low cost, and are easily maintained. Large or small boilers, utility or industrial, power or process—you can depend on Vulcan designed-for-the-job soot blower systems.

BOILER DATA

Steam Generators..Foster Wheeler Reheat Type

Capacity, each..700,000 lb per hr

Operating Pressure.....1500 psig

Final Steam Temperature...1005 F

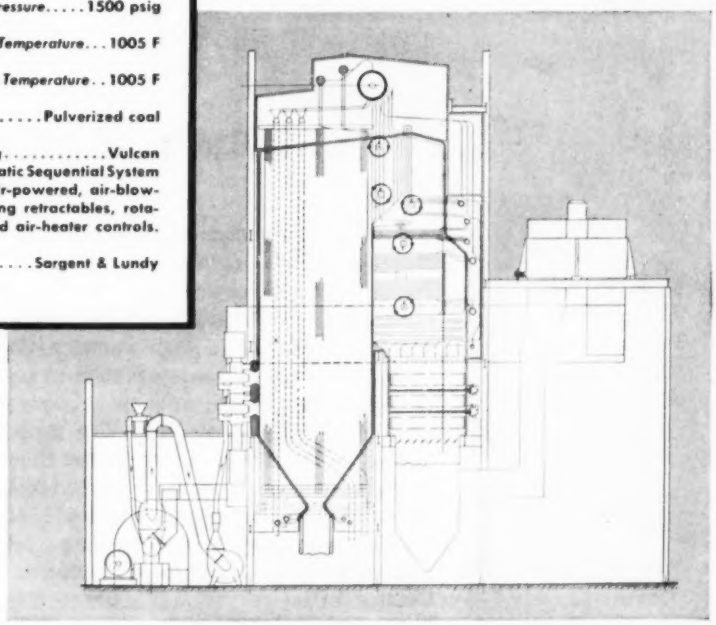
Final Reheat Temperature..1005 F

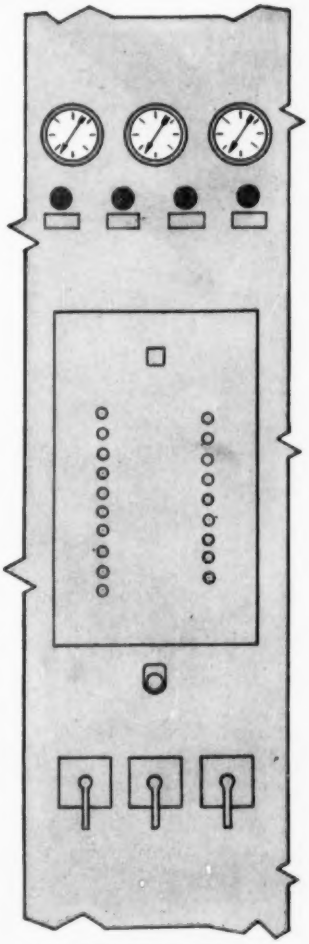
Fired by.....Pulverized coal

Soot Blowing.....Vulcan Automatic Sequential System with air-powered, air-blowing, long retractables, rotaries and air-heater controls.

Consultants.....Sargent & Lundy

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA





At Wabash River Station, all soot blower instruments and controls are grouped conveniently on the operating panel for each boiler. Automatic-Sequential Control, with only a flick of the wrist, puts all blowers in automatic or selective sequence, or they may be individually operated by push button from the central panel. Separate open or cubicle type panels are available.

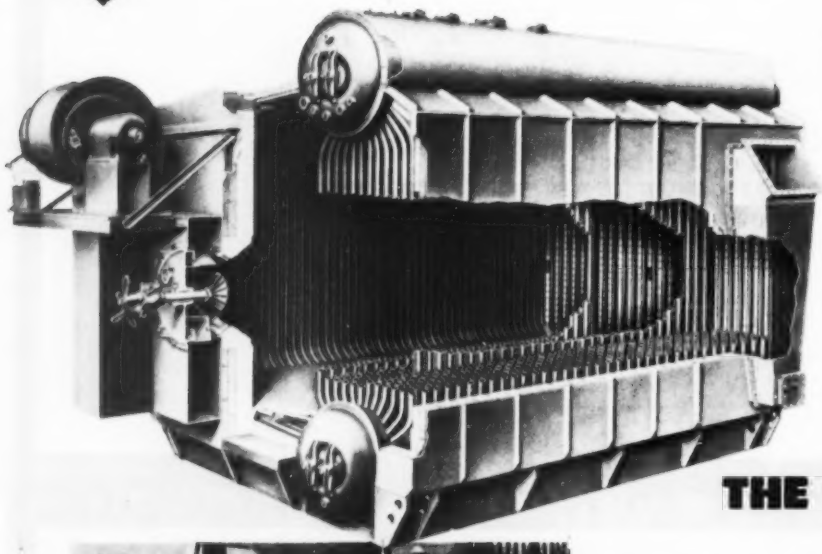
VULCAN Automatic Soot BLOWERS

For more data circle 555 on Post Card

FOR STEAM CAPACITY
choose your boiler

Whatever your fuel . . . whatever your steam capacity requirements up to 60,000 pounds per hour — you'll find one of the C-E Boilers shown here will be just right for you.

If you burn oil or gas, investigate the VP Pack-



Specifications — VP Boiler

Capacity — 4,000 to 30,000 pounds of steam per hour

Pressures — Up to 250 pounds per square inch

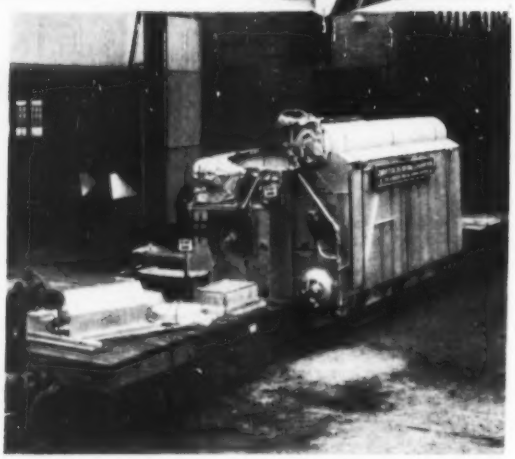
Temperature — No superheat

Fuel — Oil or gas

Erection — Completely shop-assembled

Foundation — Simple concrete slab

THE VP BOILER



The C-E Package Boiler, Type VP . . . completely shop-assembled . . . for oil or gas firing. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The large (30-in. diameter) lower drum permits a simple, symmetrical, tube arrangement . . . greater water storage capacity . . . easy access for washing down or inspection. The centrifugal fan is efficient, yet its noise level is less than half that of typical high-speed blowers used on most package boilers. Baffle arrangement is simple, resulting in low draft loss . . . simple soot blowing . . . elimination of dead pockets . . . high heat absorption. Write for Catalog VP.

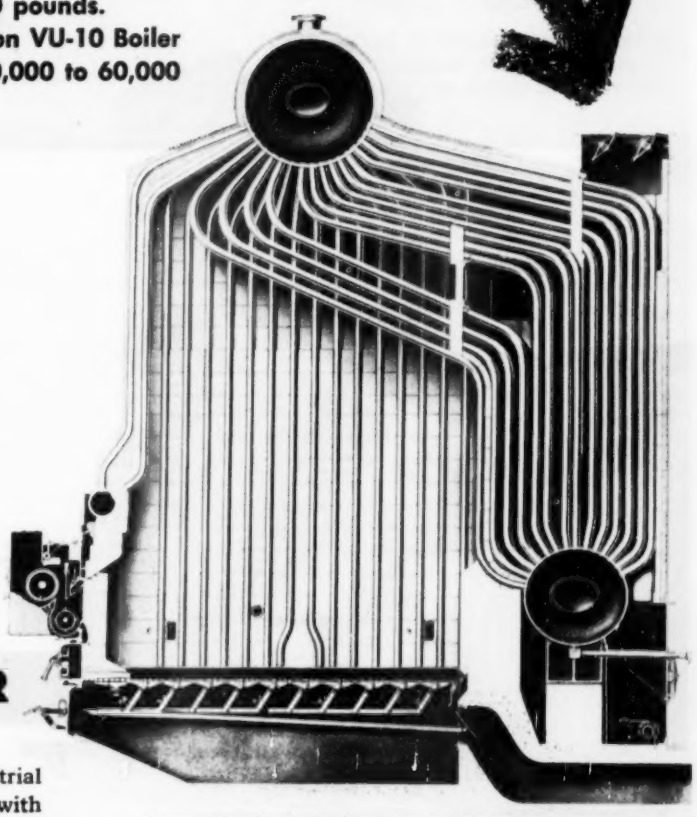
COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

UP TO 60,000 POUNDS
from these two

age Boiler for capacities up to 30,000 pounds per hour . . . the VU-10 up to 60,000 pounds.

For stoker firing, the Combustion VU-10 Boiler is available in capacities from 10,000 to 60,000 pounds of steam per hour.



Specifications — VU-10 Boiler

Capacity — 10,000 to 60,000 pounds of steam per hour

Pressures — Up to 475 psi

Temperatures — Superheat available if desired

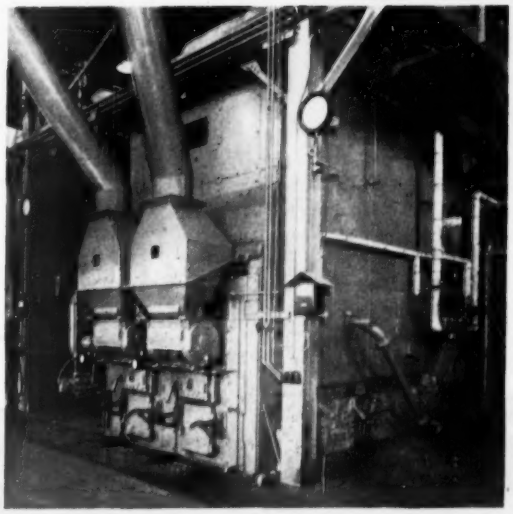
Heat Recovery — Economizers, air heaters available if desired

Fuel — Coal (C-E Spreader, Traveling Grate or Underfeed Stoker); oil or gas.

Erection — Field erected

THE VU-10 BOILER

The VU-10 Boiler is designed for industrial load conditions, particularly for plants with small operating and maintenance forces. Fuel can be either coal, oil or gas. This boiler is a completely standardized design adaptable to many conditions. It responds readily to variations in load; it is simple to operate and maintain. All parts are easily accessible for inspection. Like the VP, the VU-10 Boiler is a complete unit – boiler, furnace setting, fuel-burning equipment, controls, forced draft – bringing you the benefit of one contract . . . one guarantee . . . one responsibility. Write for Catalog VU 10-8. B-689



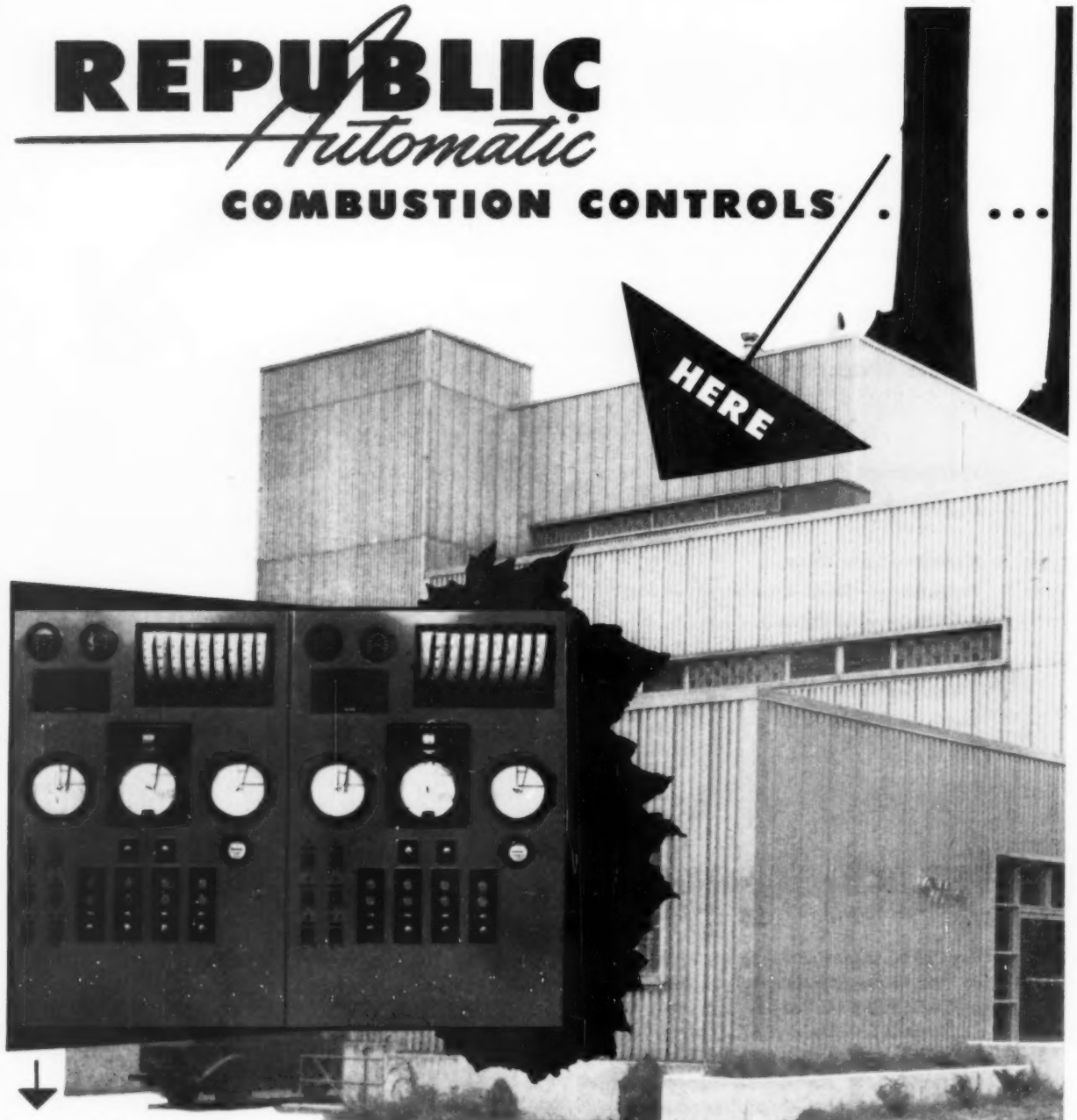
C-E

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

For more data circle 515 on Post Card

REPUBLIC *Automatic*

COMBUSTION CONTROLS . . . .



These panels are part of the automatic combustion control system for two 60,000 lbs/hr. spreader stoker fired boilers which supply steam to turbines at 600 psig and 825° F. Manual-automatic sub-panels and biasing sub-panels on the lower part of the control board provide for manual operation of the entire combustion system from this central point.

For all Types and Sizes of Boilers

Regardless of the type of fuel, size of boiler, draft arrangement or load characteristics, Republic Combustion Controls can operate boilers to hold fuel and air in the correct amounts and proportion for maximum efficiency.

WRITE FOR FULL INFORMATION
NO OBLIGATION

. GIVE MORE POWER AT LESS COST

HERE

At the Henderson, Kentucky Municipal Power Plant,

turbine generators each have a capacity of 5,000 kw. With Republic Automatic Combustion Controls, steam demand at the turbines is *automatically* matched by steam available from the boilers.

INCREASED STEAM OUTPUT

Boilers are operated at test efficiency 24 hours a day, 7 days a week.

LOWER FUEL COST

Fuel is burned at maximum combustion efficiency for more BTU's per dollar of fuel used.

LOWER MAINTENANCE COST

Operating conditions are held uniform, preventing chain-of-event troubles that frequently result from incorrect boiler operation. Ruggedly built, Republic Controls give years of dependable service.

FULL BOILER RATING WHEN NEEDED

When peak loads occur, boilers can deliver all of the steam they are rated for. Boiler capacity over the plant rating is not necessary to meet "peaks".

these Advantages can be Yours with

REPUBLIC COMBUSTION CONTROLS

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

For more data circle 556 on Post Card

When you need a good general-purpose alloy —try Monel!

Expanding Monel tube into the head of a high-pressure feed-water heater. Here's an example of where Monel's high ductility combines with its other characteristics to make it the perfect metal for the application.

Today, even the most "up-to-the-minute" metallurgist finds it hard to keep pace with all the alloys and their many applications.

But, in the power field, there is one general-purpose alloy with sufficient all-round usefulness to solve a number of metal selection problems – pump shafts, impellers, valve seats and stems, to name a few.

That alloy is Monel®!

Monel is a solid solution alloy with good strength (twice that of brass and equal to structural steel). And it retains its strength at operating temperatures of 700-800° F.

It has good resistance to corrosion, cavitation and erosion. And its high ductility provides good workability. It is supplied in all general mill forms as well as in castings.

You can get some idea of how useful Monel can be when you consider just one application —high-pressure feed-water heater tubes—where it proves to be the *only* answer.

Here's a job that calls for a strong, corrosion-resisting metal with good heat transfer properties and high resistance to erosion and cavitation. In addition, the metal must be capable of standing operating pressures up to 3,000 pounds per square inch and even higher.

Monel meets *all* these requirements!

There are all kinds of applications in which this versatile alloy can be helpful. For more information on its characteristics and uses, write for Technical Bulletin T-5, "Engineering Properties of Monel and 'R' Monel."

It is advisable to place equipment orders with your suppliers well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill.

The International Nickel Company, Inc.

67 Wall Street, New York 5, N. Y.

Inco Nickel Alloys

MONEL® • "R"® MONEL • "K"® MONEL
"KR"® MONEL • "S"® MONEL • NICKEL • LOW CARBON NICKEL • DURANICKEL® • INCONEL®
INCONEL "X"® • INCONEL "W"® • INCOLOY® • NIMONIC® ALLOYS

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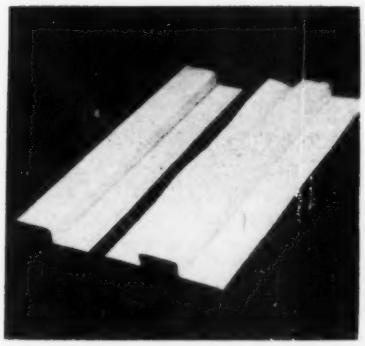


Fluorocarbon envelopes protecting gasket material have several flange shapes for easy fixing

Fluorlastic Gaskets

FLUORLASTIC gaskets are designed to serve where previous materials have failed. Their chief applications are chemical, air frame, and oven door gaskets. They combine for the first time the resilient properties of heat and cold resistant silicone rubber with the ice repellant, tough, chemically inert properties of the fluorocarbon resins, Teflon and Kel-F. These* new gaskets are easy to install, either in the factory or in the field. Ordinary rivets or cold cements are generally used.

Compare this combination of four exceptional characteristics obtainable in Fluorlastic gaskets with your present gasket material.

1. Useful from — 65 F to 500 F.
2. Unusual surface properties:
   a. Non-sticking.
   b. Ice and water repellant.
   c. Chemical and oil resistant.
   d. Tough: tear and abrasion resistant.
3. Controlled softness or firmness.
4. Sized and shaped to suit your needs.

The silicone core is available in various diameters, either solid or as silicone sponge. The envelope of Kel-F or Teflon ranges in thickness from 0.0025 in. to 0.030 in., depending on requirements.

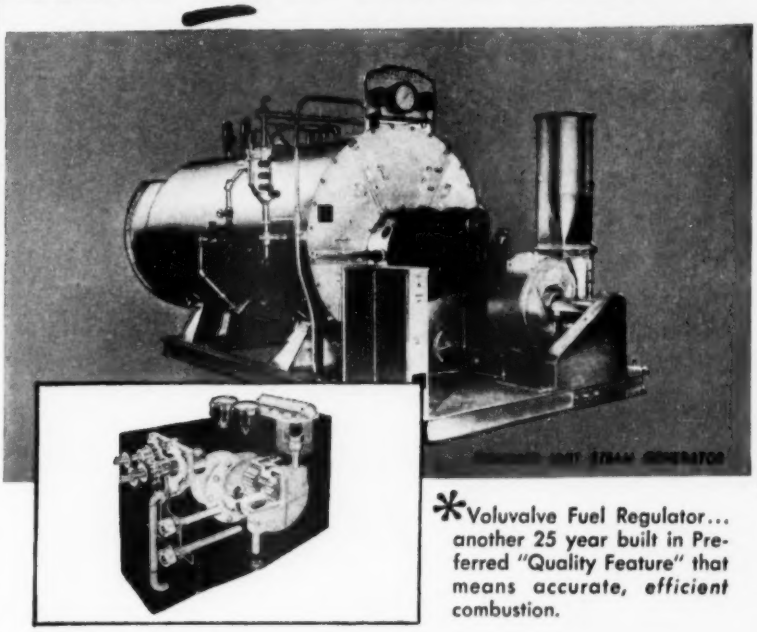
Strip-type gaskets in various shapes and sizes, in lengths up to 96 in. and widths of 4 in., are available with both Kel-F and Teflon envelopes. These gaskets, readily mountable, are used for hood, duct and oven closures where corrosive conditions are present.

In ring form for flange gaskets, Kel-F envelopes are generally used because a completely impervious covering can be formed which will withstand complete immersion in highly corrosive substances.

* Teflon is a registered trademark of E. I. du Pont De Nemours & Co.; Kel-F is a registered trademark of M. W. Kellogg Co.

For more information about this new gasket material, just write "Gaskets" on the prepaid post card elsewhere in this issue and mail it to us.

there *IS* a difference*



*Voluvalve Fuel Regulator... another 25 year built in Preferred "Quality Feature" that means accurate, *efficient* combustion.

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Preferred's Unit Steam Generator handles any and *all* the variations of Bunker "C" and No. 6 oil that are coming through these days from catalytic cracking . . . and they do it *better* and *more efficiently* than any other unit steam generator on the market because—

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**No other unit has Preferred's High-Speed Atomization* —taking the metered fuel, Preferred's rotary cup speeds at *4600 RPM* and easily atomizes the most viscous oil to a fine spray. Higher air velocities provide for greater collision effect and better atomization and allow complete control of spray angulation for carbon-free operation.

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- ☐ BLANKETS . . . Metal reinforced, flexible, felted, rockwool insulation

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Costs for Handling Coal

(Continued from page 73)

cent moisture) capacity of 45 tph of minus 1 1/2 in. coal. Discharge coal is dried to 4 per cent moisture at 40 tph (5 tph of water having been removed) to conveyor (10) for screening, crushing, and re-screening.

The dryer (Fig. 3) has interesting features. The rotating drum has internal tangential and radial louvre plates which form passages for the hot gas forced in by the inlet fan. As the drum rotates, the coal bed slips at the angle of repose and also moves along toward the discharge end without drag against the louvre plates. As the coal moves forward the bed becomes thicker, the passages smaller, and the volume of hot gas penetrating the bed is reduced; thus, overheating is avoided. Exhaust is through a dust collector.

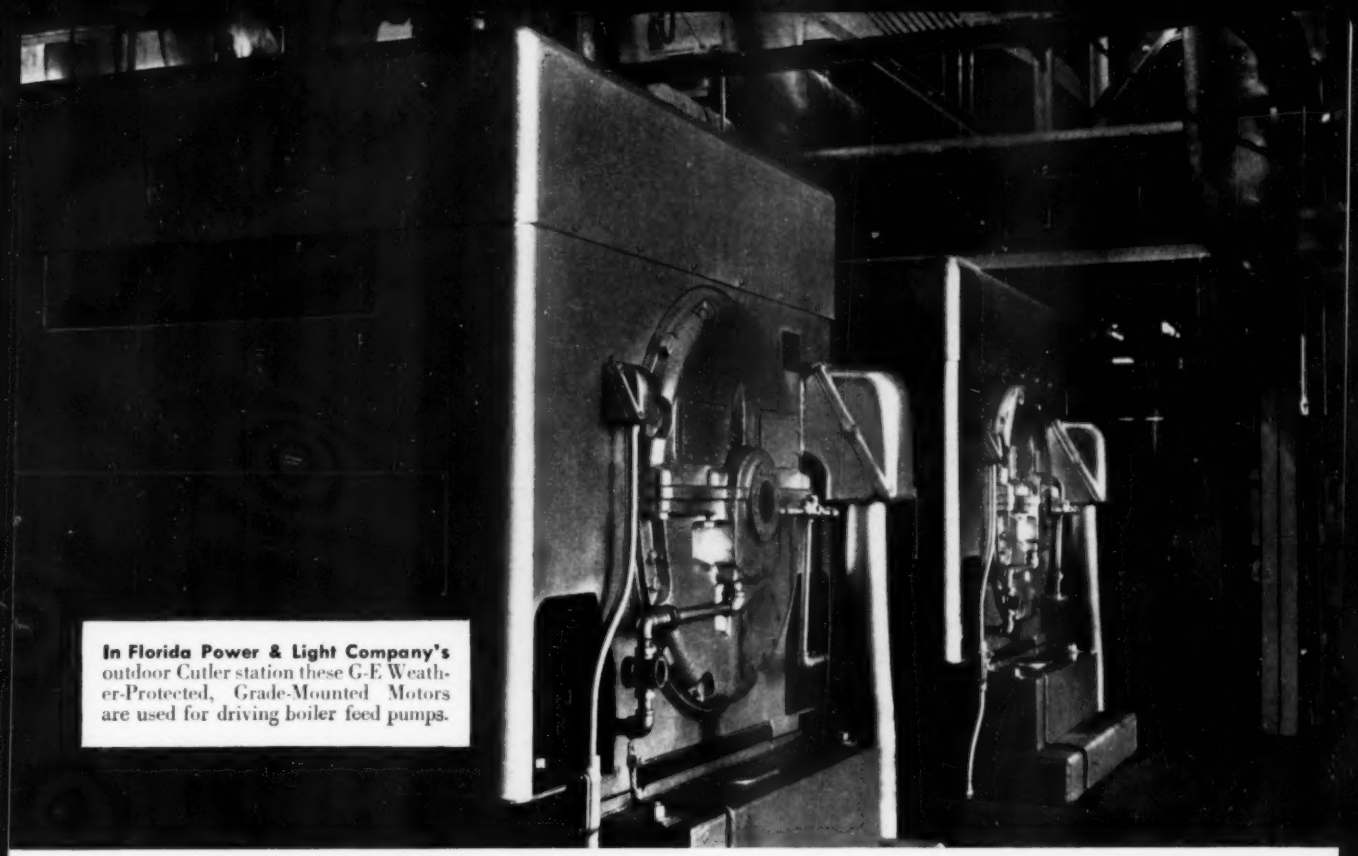
The drying gas at 700 F is provided by a stoker-fired furnace which uses about one ton of coal per hour, and a fan with a capacity of 70,000 cfm. About 2 1/2 per cent of the coal dried is used by the dryer when drying from 15 to 4 per cent surface moisture. However, when drying coal with 8 per cent initial moisture to 4 per cent, the dryer capacity is about 80 tph and the percentage is less.

It has been found that with surface moisture in excess of 6 per cent there would be occasional blinding of the vibrating screen, arching in the chutes, and some rat-holing in the bunkers. Interruption of flow to the cyclone-type burners means immediate loss of steaming capacity. When the moisture is less than 6 per cent, however, the coal flows freely.

It is at times desirable to re-handle the coal from the lower sections of the silos to the top of the pile, either to prevent heating, or to prevent compacting. In Fig. 2, coal from either silo feeds to conveyor (6) which discharges to the silo loading conveyors. All units are inter-locked in the usual manner and, with the exception of conveyor (6), are controlled from a central station.

It is disconcerting to find that the cost per ton for handling from cars to bunker, or rather to the boiler room floor, often is lower in the small plants using a few thousand tons per year than for the large plants using many times more. This is because in the small plant two or three men attend to the job as part of their regular duties, whereas in the larger plants there is a regular squad which when not unloading cars is engaged in cleaning up, maintenance and repairs, all of which are charged to coal handling.

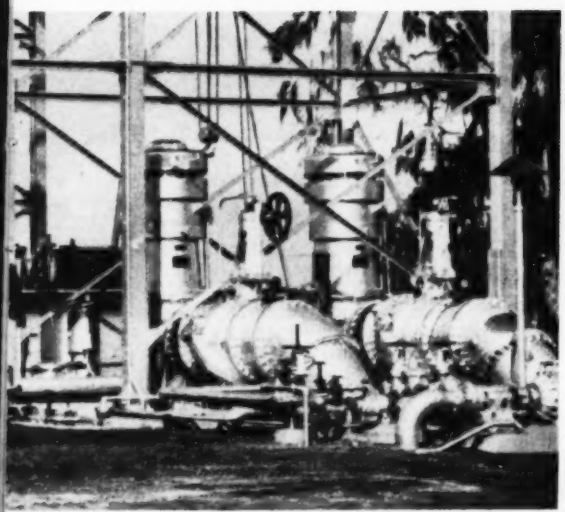
Table I lists nine public utility plants varying from 14,250 to 74,500 kw capacity, with the tons per year and the labor costs per ton handled. Labor costs are based on an average wage of $1500 per year per man. (As



In Florida Power & Light Company's outdoor Cutler station these G-E Weather-Protected, Grade-Mounted Motors are used for driving boiler feed pumps.

Designed specifically for outdoor, all-weather applications . . .

G-E Weather-protected Motors Provide Vital Continuous Service



G-E Weather-Protected Vertical Motors coupled to circulating water pumps operate outdoors in all weather at Florida Power & Light Company's Palatka Station.

Here's a low cost motor that the weather can't stop. For vital outdoor power station service, you can always count on reliable performance from rugged G-E Weather-Protected Motors . . . in all kinds of weather. An extremely effective ventilating system minimizes entrance of rain, snow, sleet and other airborne particles. Windings and other internal parts stay dry . . . assure you of dependable, all-weather service at minimum installed cost.

You get another big plus from industry's first successful outdoor weather-protected motor . . . the long-life quality developed in building over 2½ million horsepower of motors for power stations.

For complete information on these and many other features, contact your nearest G-E Apparatus Sales Office or write for Bulletin GEA-5810. General Electric Co., Section 753-5, Schenectady 5, N. Y.

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Tips on TESTING . . .

. . . ELECTRICAL INSULATION RESISTANCE

Reconditioning Wet Apparatus

The bad effects of excessive moisture in insulating material, particularly when localized, are numerous. The effect most likely to result in failure in the early stages of exposure is that of low resistance paths which may develop either through or over the surface of the insulation. The likelihood of failure from this cause is increased by the presence of dirt and other foreign matter, and may occur in either organic or inorganic insulating material.

If moisture has been deposited on clean insulation only superficially, then the heat resulting from the normal operating temperature of the equipment may remove it before failure occurs. However, the normal operating heat of at least some parts of the equipment is sometimes insufficient to drive out moisture that has penetrated through surface defects.

If moisture is allowed to remain in insulation, it usually—in time—causes corrosion of metal conducting parts, aggravated by the presence of chemicals and electric potential, thus increasing the danger of failure.

In addition to apparatus which may be exposed to moist atmosphere, or wet with fresh water, there may be occasions when it becomes necessary to rehabilitate equipment that has been subjected to salt water. In such case, clean fresh water must be used to remove all traces of salt before drying of the apparatus is attempted. Any evidence of oil or grease on the insulation should also be removed by using a volatile solvent such as carbon tetrachloride.

Then the apparatus must be dried out before electrical potential is applied. Numerous methods and various temperatures for drying out electrical equipment are used, including forced hot air, ovens, circulating electric current through the conductors, or combinations of these methods. Local conditions and facilities, manufacturer's recommendations, and the type of equipment involved, dictate the method used.

Test Procedure

If possible, secure records of previous insulation resistance tests on the apparatus.

Make short-time tests and time-resistance tests for comparison to help decide whether drying is necessary. If present readings are at all comparable with previous tests made at or corrected to the same temperature, a drying-out run *may* not be necessary.

NOTE: *The above material is taken from our Instruction Manual—for the use of Megger Insulation Testers. Within its 96 pages, such subjects as "Temperature Correction", "Interpretation" and many others are discussed in a clear and interesting manner with very ample illustrations, charts and tables. We'll be glad to send you a copy of this manual without obligation. Just write on your company letterhead for* ***Manual 21-J-PE.***

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of 1953, the $1500 per year obviously must be given quite a boost.)

A reasonable breakdown of fixed charges would be: taxes and insurance, 2 per cent; maintenance, 2 per cent; depreciation, 7 per cent; interest, 5 per cent; total, 16 per cent. The total cost for the coal handling equipment at station H was approximately $150,000, and with the above allowances the total cost per ton would be:

	Cents
Labor	8.7
Fixed charges	15.5
Total cost	24.2

Of course the coal-handling cost is only a fraction of the total production cost, but the coal handling installation is nevertheless important; especially so is its reliability. Illustrating the relative costs in a pulverized coal burning station of high efficiency, we return to Station H in Table I. Incidentally, this station was designed by the late James A. Powell and fulfilled his ambition to beat one pound of coal per kilowatt-hour. He made it with quite a margin — 0.896. Operating figures for Station H are given in Table II.

The figures in Table II relate to the Associated Gas and Electric Co. plant at Holland, N. J., which since has been greatly increased in kw capacity. The total cost for coal handling ($38,000) is 4 per cent of the total production cost ($961,300).

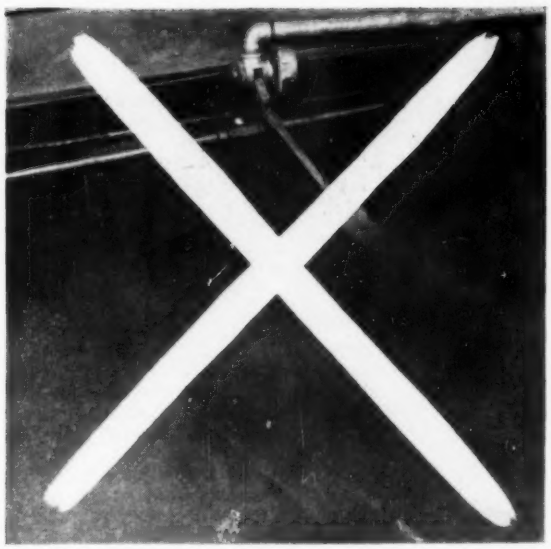
It has been interesting to observe the trend in steam plant coal handling equipment specifications. Most notable of the trends is in the emphasis now placed on dustless operation. Every effort is made to secure clean operation. When possible, reserve ground storage is located well away from the plant. There is also a trend to more general use of continuous flow conveyors in the smaller plants as their possibilities and limitations have become better known. Their cost, as a rule, is far less than that of a bucket elevator and feeder and distributing conveyor. With the development of pneumatic and hydraulic methods of ash disposal, the pivoted bucket carrier for the dual duty of coal and ashes handling seems to be less frequently specified.

120-V Nicad Batteries

(*Continued from page 71*)

labor cost of $3.50 per hour, including overhead, rather than upon the actual wages paid to the electricians.

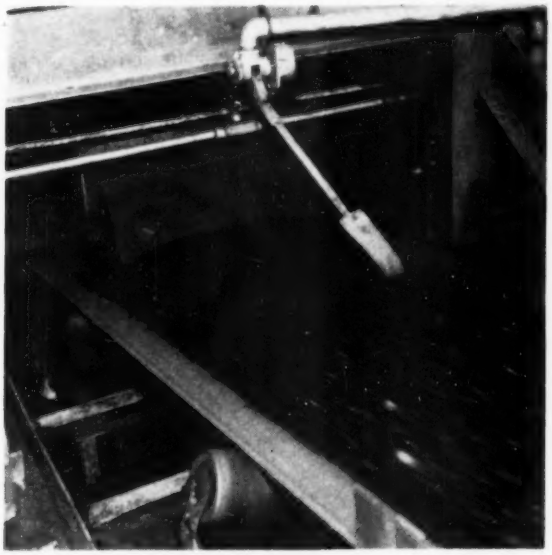
Allowing one-half hour for each of the four battery checks gives a total yearly labor cost of $7.00. Allowing an hour for each of the weekly checks required with the lead-acid battery gives a yearly total of 52 hours for a labor cost of $182.00. Savings are $175.00 per battery and, on the three-battery installation, give a total yearly savings of $525.00.



BEFORE—View of Coal Chute discharge onto conveyor belt at a New Jersey generating station without J-M system turned on.

STOP COAL DUST

in your operation at 1/10 the usual cost!



AFTER—Same view as above but with J-M dust control system in operation.

For more information on how a low-cost Johnson-March system can help solve *your* coal dust problems, send NOW for this FREE ILLUSTRATED BROCHURE.

Here's improved appearance for your plant . . . better health for your employees . . . easier handling of your coal supply. A Johnson-March system can control or eliminate coal dust wherever it occurs in your operation *. . . at a cost only 1/10 that of most other dust control systems!*

A Johnson-March system can be installed right at car dumpers, hoppers, crushers, belt galleries or coal piles. Nothing to interfere with normal operations. So amazingly simple the maintenance cost is next to nothing.

Johnson-March systems are installed in many plants to improve the effectiveness of existing mechanical dust collection systems. If you now have no control over coal dust . . . or even if you have a mechanical dust collection system in your plant . . . it will pay you to consider the *low-cost* advantages of a Johnson-March system.

THE JOHNSON-MARCH CORP. PE-6
1724 Chestnut St., Philadelphia 3, Pa.

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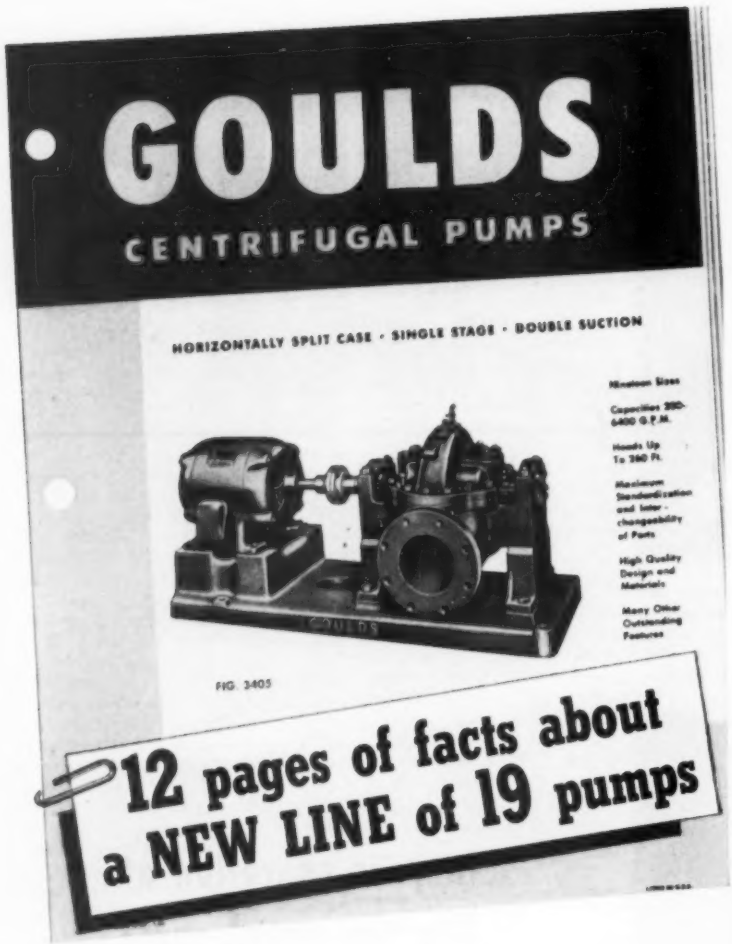
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The quickest way you can really discover what the new Goulds Fig. 3405 centrifugal pump can do for you is to read the descriptive bulletin pictured above.

Here are some hints of what you'll find:

The quality of materials and extras of design that you have been able to get only by paying extra are *standard* on this new pump: stuffing box bushings, stainless steel impeller keys, Teflon water seal rings —to mention a few.

The Fig. 3405 carries interchangeability of parts far beyond anything we've been able to do before. Only three shaft and rotating parts assemblies (exclusive of impellers and wearing rings) provide for 19 pump sizes.

This means real spare parts inventory savings for any plant that uses many pumps. It also means easy-to-make field changes to meet new requirements.

We've come as close as modern design and materials allow to putting into this new pump what our industrial customers have told us they want. The 12-page illustrated bulletin tells you all about it. We'll be glad to send you a copy.

To get a copy of Bulletin 721.6, get in touch with the nearest Goulds representative or just fill in the coupon, pin it to your letterhead and mail it to us at your convenience.

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Dept. PE, Seneca Falls, N. Y.

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Merrimac Power

(Continued from page 77)

future burning of coal on a spreader stoker, thus securing the advantages of multi-fuel operation.

If this is done, the new boiler will be designed to generate superheated steam at 600 psi so that, if desirable, a 600-psi steam turbine generator, exhausting at 125 psi, could be installed to top the existing paper machine turbines. The latter could be converted to 125-psi operation by simply changing the nozzles. Such an arrangement would not only generate some very low-cost electric power but would also obtain the compactness, ease of operation and high steam generating economy possible with high-pressure boiler units.

As a result of the foregoing modernization program, first steps of which have already been carried out, Merrimac Paper Co. will have a power system that will greatly improve reliability and continuity of operation and reduce steam and power costs still further to meet competitive conditions. Combination of generated and purchased power and steam turbine paper machine drive provides a good heat balance, and much flexibility in operation.

Installation and operation of the above power equipment are under the supervision of this writer, with Charles T. Main & Co. of Boston, Mass., serving as consulting engineers. The work is carried out by the Merrimac engineering staff, which consists of: Henry Mika, chief electrician; John Morrison, master mechanic; Ed Cormier, chief power plant engineer. Murray Howe is general manager of the mill and C. H. Child is technical director.

140% Modernization

(Continued from page 98)

ence with other industrial boiler plants, as well as the one described in this article.

Another item, not to be overlooked, is the possibility of getting additional steaming capacity. Very often, having automatic controls will increase the continuous steaming capacity of a boiler without unduly increasing operating costs, since combustion is always held under control.

If the demand for steam is high, this may postpone the need for adding additional steaming capacity and thereby save many times the cost of the control system. This does not necessarily imply that boilers should be pushed beyond manufacturer's rating, but it is often uneconomical to operate boilers at maximum rating just because they are difficult to control. In these situations the addition of a good combustion control system can often save the cost of a new boiler.

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Year after year users of condenser tubes and plates specify Revere, not only for new equipment, but when re-tubing. You might consider this fact if you are not as yet a Revere customer.

Correct specification is vitally important, because conditions vary so greatly. Each installation presents an individual combination of factors, each one of which should be studied before deciding on the proper alloy. It is often advisable to make a new survey of the situation before re-tubing, because the nature of the cooling water may have changed, or other service alterations have taken place.

To find the alloy or combination of alloys best suited to meet a specific set of circumstances, Revere offers the help of its Research Department, made available through the Technical Advisory Service. Working with the country's leading users of condensers and heat exchangers, these capable consultants have helped solve many and varied types of problems, leading to longer tube life.

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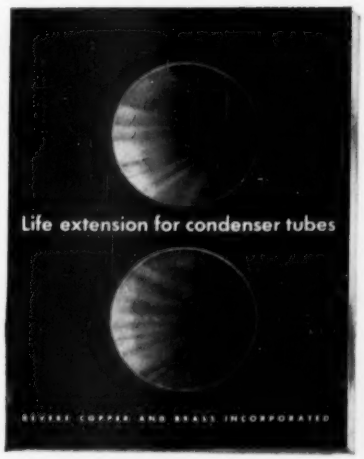

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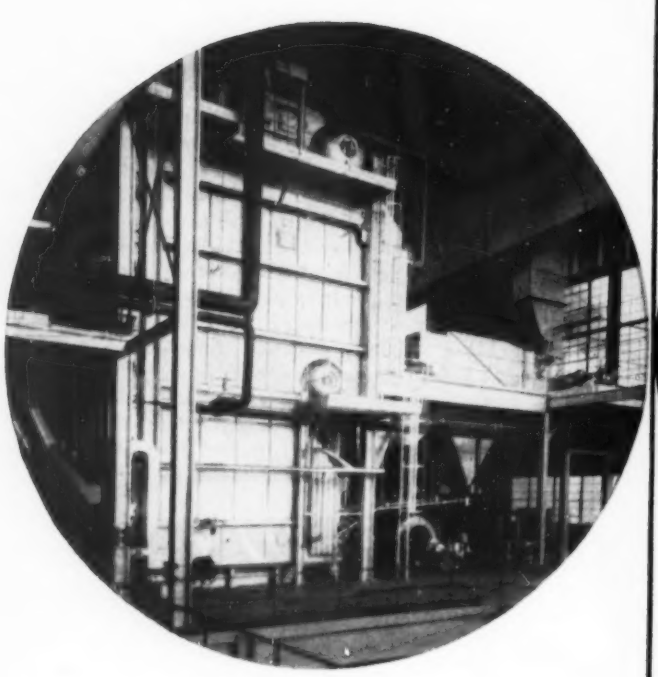
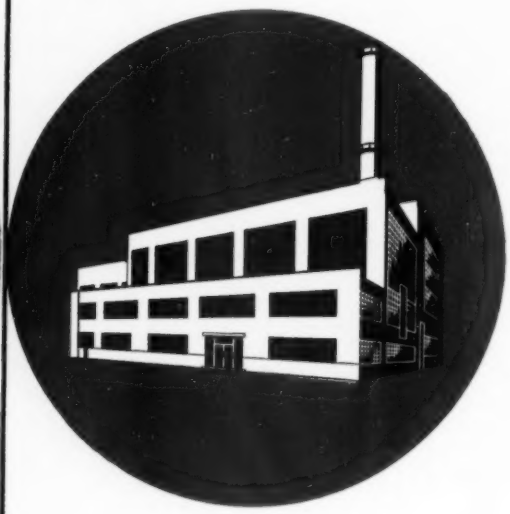
City of Manitowoc installs fifth WICKES steam generator

To provide a dependable source of power for the City of Manitowoc, Wisconsin, the Manitowoc Public Utilities Commission has just installed a fifth WICKES Steam Generator capable of producing 175,000 lbs. of steam per hour at 525 psi. Final steam temperature is 750°F. The new WICKES Boiler has 11,600 sq. ft. of heating surface. It is equipped with an economizer and fired by spreader stoker.



R. E. Connard — Chief Engineer and General Manager



WICKES can fill your requirements for all types of multiple drum boilers generating up to 250,000 lbs. steam per hour at pressures up to 1000 psi. adaptable to any standard method of firing — oil, gas, single retort underfeed or spreader stoker. For pressures up to 900 psi. with sustained steam production up to 35,000 lbs. WICKES Type A Boilers can be shop assembled, ready for immediate installation. Write today for descriptive literature or consult your nearest WICKES representative.

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Fuel Oil Additives

APPLICATION of Additives to Fuel Oil and Their Use in Steam-Generating Units. A.S.M.E. Paper No. 52-A-160, J. B. McIlroy, Group Leader, Fuels Section of Chemical Laboratory, The Babcock & Wilcox Co., Alliance, Ohio; E. J. Holler, Jr., Associate Chemist, Research Development Division, also with B & W, Alliance, Ohio, and R. B. Lee, Assistant Superintendent of Power Production, Florida Power Corp., St. Petersburg, Fla. Paper first presented at annual meeting, New York, Nov-Dec. 1952; re-presented at semi-annual meeting, Los Angeles, Calif., June-July 1953.

It is recognized that troublesome deposits are characterized by a high content of low-temperature melting constituents. In this paper the authors are concerned with the addition of high-temperature melting-point compounds to the fuel oil to elevate the melting point of the whole above the troublesome temperature level. The field tests and research on this project were reported in the December, 1952 issue of POWER ENGINEERING In this ASME paper the authors describe the laboratory and pilot-furnace-firing, tests, and also the full scale operational runs at the Inglis Station of the Florida Power Corp. Test results are listed in diagrams and tables.

Alumina was found to be the best material at first, with magnesium and calcium oxides showing promise. Alumina later was replaced by dolomite. Both materials raised the temperature of fusion of the ash to a satisfactory level.

Among the results obtained by using fuel-oil-additives at Inglis Station were the following:

1. The usual rock-like deposits on heating surfaces were changed into a powdery, easily removed substance that permitted uninterrupted operation by lancing with 200 psi air twice a week.

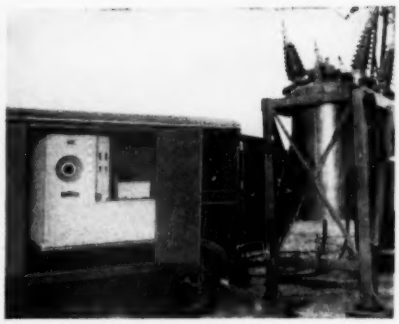
2. When using Dolomite as an additive, the cost of maintaining an operably clean boiler was reduced from 7.3 cents per bbl of oil without additives to 0.78 cents with dolomite.

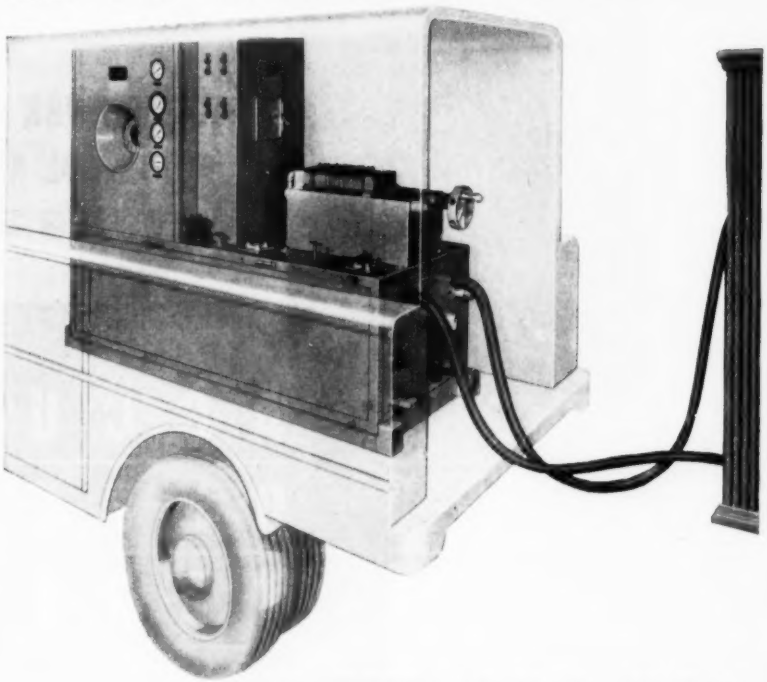
3. The experiments indicated that dolomite tended to lower the dew point of the flue gases, reduce corrosive quality of fumes from the stack, and lessen the nuisance from fly-ash.

4. Because of the foregoing, the Florida Power Corp. is adding dolomite in an amount equal to the ash in the oil as regular operating procedure at their Inglis Plant.

The authors point out that in evaluating their results it must be remembered that the method described is relatively new, and though it has proved successful with the type of oil used at Inglis and the unit in operation there, problems might arise under different conditions. However, their experiments have prepared the way for a better understanding of the problem of deposit formation.

NO service interruptions





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VERSATILE

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DEPENDABLE This is assured by the sound, sturdy construction of all Hagan components. Hagan engineers are familiar with the problems of field operation. This knowledge is brought to bear on the design. As a result, Hagan equipment is still operating efficiently in many steam plants built twenty or thirty years ago. The third basic guide for Hagan design is that each component must be . . .

VERSATILE Every unit in the Hagan System of Combustion Control and Instrumentation is integrated with the rest. This means that, whatever the requirements of your plant, in terms of number and size of boilers, combinations of fuel, load fluctuations or pressure conditions, a system can be tailor-made to fit exactly. Accurate—Dependable—Versatile—Hagan Combustion Control and Instrumentation assure optimum operating efficiency for your plant.

Let Hagan engineers help you solve your control and instrumentation problems. They can make available to you the experience gathered from thousands of successful installations.

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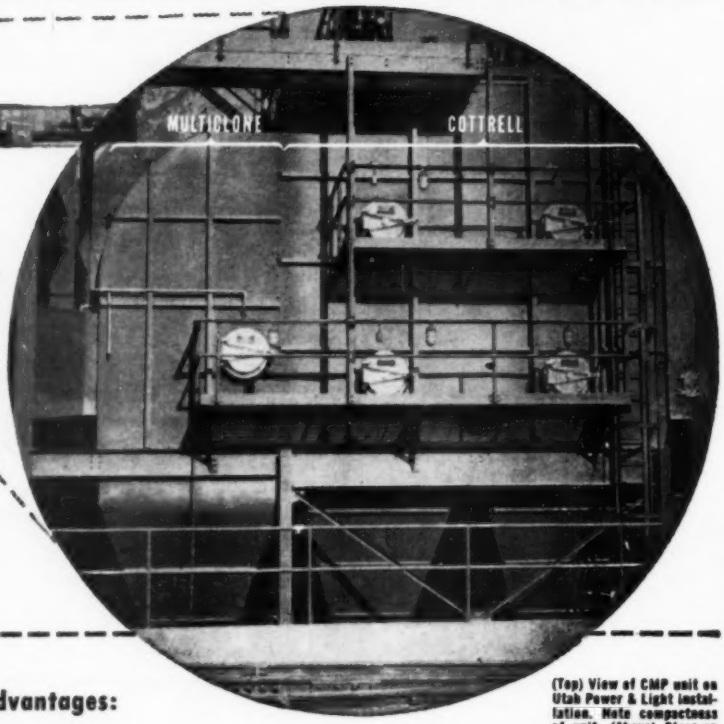
Consider these important advantages of a WESTERN PRECIPITATION CMP UNIT!



IF YOU are planning the installation of any type of fly ash recovery equipment—mechanical or electrical—it will pay you to investigate the extra advantages to be gained by installing a CMP Unit designed, engineered and constructed under *one* responsibility by Western Precipitation Corporation—*leaders in both electrical and mechanical recovery fields!*

(Top) View of CMP unit on Utah Power & Light installation. Note compactness of unit. (Above) Close-up of same installation.

Combines Mechanical and Electrical Advantages:

A CMP (Combination Multiclone-Cottrell Precipitator) Unit combines—in one compact installation—both mechanical and electrical recovery principles, so that maximum benefit is obtained from the advantages inherent in each method. The MULTICLONE section centrifugally cleans the gases of the larger and heavier fly ash particles (down to a few microns in diameter) . . . and the COTTRELL Precipitator then electrically removes the very small particles remaining in the gases. This combination arrangement has important advantages:

1. Using the MULTICLONE for cleaning out the heavier particles permits the bulk of the recovery operation to be performed with relatively low-cost equipment.

2. Using the COTTRELL for final clean-up insures unusually high recovery efficiency—approaching theoretically perfect, if desired—with a high efficiency, compact Precipitator unit.

3. Each type of unit—MULTICLONE and COTTRELL—can be arranged for its most efficient application. MULTICLONES may be connected to each separate boiler, if desired, and their draft requirement cut out when the boiler is down . . . while a central COTTRELL handles all gases and operates at higher efficiencies, with continued low power cost, when one or more boilers are down.

4. During soot-blowing periods, or while warming up cold boilers, the MULTICLONE efficiency usually increases, preventing overloads of detrimental carbon from reaching the COTTRELL.

Only Western Precipitation Combines Multiclone and Cottrell "Know-How"—In ONE Organization!

A vital factor in obtaining maximum efficiency and economy in CMP installations is the proper balance of mechanical and electrical recovery equipment to the individual requirements of *each* application. Western Precipitation is unique in that it not only pioneered the commercial application of COTTRELL Electrical Precipitators over 43 years ago, but also has been a leader for many years in the *mechanical* recovery field with its widely-recognized MULTICLONE Collectors.

Result—Western Precipitation has the all-important "know-how" and experience in BOTH fields . . . knows from first-hand experience how to fit the *right* equipment in the *right* place, to do *your particular* job . . . and can provide the complete installation under ONE responsibility and ONE overall guarantee!

Let Our Experienced Engineers study your recovery requirements and make recommendations on the equipment best suited to your operations. A wire, phone call or letter to our nearest office places this unique "Know-How" at your service, without obligation!

Send for descriptive literature!

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

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HELPFUL BULLETINS

(Continued from page 38)

refineries, chemical industries. Also pictures panel components. Panellit, Inc.

131 Television for Gages — Bulletin WG-1813 describes and pictures television equipment for use with company's high pressure water gages. Discusses features of this RCA equipment, describing camera and monitor units in detail. Yarnall-Waring Co.

132 Flow Meters — Catalog 10-A-10, 16 pp, discusses flow meters and presents comparisons between popular variable-area types and the more common variable-head meters. How the variable-area meter works, its basic flow equation, as well as information on calibration scales, metering range, permanent pressure loss, upstream piping effects, viscosity effects, purging are discussed. Fischer & Porter Co.

133 For Mechanical Trouble Shooting — This bulletin describes and pictures the Serviceman Soundscope, an inexpensive instrument for detecting and identifying mechanical troubles by their sounds. Tells how the instrument can be used to check bearings, find leaks, isolate knocks and slaps, check mechanisms. Marsh Instrument Co.

PAINTS AND COATINGS

134 Reference Data on Insulation Protection — This booklet, about 20 pp, is a revised reference manual describing in detail 36 of company's coating and adhesive products for use in the installation and surface protection of industrial insulations. Technical data, recommended uses, citation of appropriate specifications and other facts are given. Manual is available to qualified power engineers concerned with thermal or acoustical insulations and the protection of insulated pipelines and equipment. Benjamin Foster Co.

135 High Cost of Cheap Paint — Service Bulletin 120 is an educational leaflet on the economics of protecting metal with paint. It charts probability of early failure correlated with paint film thickness. Data from plant records shows comparative costs of labor and material required to attain minimum thickness with variously priced paints. Carboline Co.

PIPING, HOSE AND ACCESSORIES

136 Welding Fittings — This 36-pp revision of company's W-3 Catalog covers WeldOlets and ThredOlets for piping services. Serving as engineering reference book as well as ordering guide, catalog provides sizes, weights, prices; installation instructions and a technical section covering design, engineering and material specifications. Bonney Forge & Tool Works.

137 Metal Hose and Joints — Selection and installation data necessary to the application of flexible metal hose and pipeline expansion joints are discussed in Catalog CMH-128, 16 pp. Specifications for low and high pressure units are given, also specification data for corrugated and convoluted hose constructions, information on fittings, and coverage of special purpose assemblies available. Flexonics Corp.

138 Flexible Metal Hose — Bulletin 15-D covers high pressure interlocking bronze and steel flexible hose, tar and asphalt hose, and loading and unloading hose and couplings. Lists current applications and engineering data. Atlantic Metal Hose Co., Inc.

139 Pipe Tools — This 8-pp, quick-reference catalog covers company's line of pipe and bolt threaders, square and saw-ing vises, pipe reamers, cutters, and pipe and bolt machines. Ordering specifications, prices given. Beaver Pipe Tools, Inc.

COAL HANDLING

140 Spreader Stoker — Sixteen-pp Bulletin 300 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash removal. Explains this continuous cleaning feature in detail, along with other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

141 Crawler Tractors — A ten-pp catalog shows construction details of the company's four diesel-powered crawler tractors. Full cutaway drawings give an "inside and out" picture of the 40-, 72-, 109-, and 175-drawbar hp models, and photos illustrate job applications for each. Tractor Div., Allis-Chalmers Mfg. Co.

SANITATION

142 Sanitary Engineering — This 34-pp brochure shows by text and pictures how company has incorporated new developments in waste engineering in the design of sewage and industrial waste projects for municipalities, industries. About 50 installations are shown. In a pocket of this book is a smaller booklet containing project and client lists. Gilbert Associates, Inc.

143 Efficient Chlorination — Pocket-size Form A-705, 24 pp, outlines the uses of Pittchlor, a calcium hypochlorite with a minimum of 70 per cent available chlorine. The advantages of this product for water and sewage treatment and general sanitation are listed, and a table gives solution strengths for various uses. Columbia-Southern Chemical Corp.

OTHER EQUIPMENT

144 Silicone Packing Products — Bulletin AD-147, 8 pp, describes silicone rubber diaphragms, gasketing, sheet packing, oil seals, rings, insulation tape, rod and valve stem packings, and molded shapes for many industrial uses. Characteristics and applications of silicone rubber are described. The Garlock Packing Co.

145 Data on Stress Values — Data Card 154 is designed to help power engineers concerned with the operation of tubular equipment at elevated temperatures and pressures. The card is an adaptation of Table P-7 of the new ASME Boiler Code and is complete with notes and formulas for calculating maximum allowable working pressures. Tubular Products Division, The Babcock & Wilcox Co.

146 Small Industrial Pumps — Catalog 101, 12 pp, covers a line of small industrial pumps for lubricating, hydraulic, transfer, circulating and burning oils service. Presents the services, operating data and features for each model for easy selection of proper pump for a particular application. Performance data and specifications included. Tuthill Pump Co.

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Catalog Library

THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, may appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the catalogs and bulletins. Use the postage-free card below for your request

TUBING AND ACCESSORIES

201 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are presented, as are specifications, conversion tables, and weights. Scovill Mfg. Co.

202 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

203 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

204 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

205 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

206 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

207 To Avoid Tube Corrosion — Bulletin TR-514 is an 8-pp illustrated article discussing corrosion as a major factor in shortening the life of boiler tubes. Indicates that, in low pressure boilers, corrosion is the largest single cause for replacement of tubes. Points out types and causes of corrosion and gives general rules to follow to get maximum service life from boiler tubing. Tubular Products Div., The Babcock & Wilcox Co.

BOILERS, GENERATORS

208 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions and standard and accessory equipment for the units which range from 20 to 6000 hp, for pressures to 250 psi. Preferred Utilities Mfg. Corp.

209 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions and weights given. The Babcock & Wilcox Co.

210 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Use of generator with various fuels and firing arrangements is covered. Erie City Iron Works.

211 Steam Boilers — Form SG 128-749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of company's boilers. Cleaver-Brooks Co.

212 Scotch Marine Boilers — Bulletin 236 illustrates and describes a Scotch type of boiler on skids suggested for a wide range of applications. This boiler can be hand- or stoker-fired with coal or can use oil, gas or wood as fuel. Gives construction details, stresses versatility, other advantages. Includes test data and specifications. The James Leffel & Co.

213 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

GAS AND OIL BURNERS

214 Gas Burners — Illustrated Bulletin 410-8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners,

October 1953
Card valid in 6 months

POWER ENGINEERING

Please have the manufacturer send me without obligation information or bulletins indicated by the number circled below.

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Helpful Bulletins

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Use this space to ask for test sheets and other information.

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 1 | OCTOBER 1953 | Number 5

Expert Knowledge Solves Process Problems

A hurry-up call from a Hall field engineer sent C. T. Roland, Pittsburgh headquarters expert on metal preparation and paint finishing to confer with a west coast automobile plant on a paint blistering problem. The sudden occurrence of the blistering baffled the plant engineers until Roland investigated the possibility of a change in the source of the water used in final rinsing of the metal before paint was applied. He found that the quality of the water supply had changed shortly before the blistering developed. Analysis showed that this supply was higher in pH and dissolved solids, particularly sodium chloride, than the water previously used. Mr. Roland's experience in dealing with the action of soluble salts under paint films led to the conclusion that in this case the paint was acting as a semi-permeable membrane, allowing the passage of moisture from the outside surface of the paint to the salty underlayers. Blisters formed wherever the osmotic pressure of the salt solution exceeded the bond of the paint to the metal. The higher alkalinity of the water contributed to the loss of adhesion, promoting further separation of the finish from the metal.

With the cause for the trouble established, recommendations were made to obtain a water supply low in solids until the plant could install equipment to insure the constant delivery of water of suitable quality for this operation.

In another case where specialized knowledge was useful, Ralph Thompson, specialist on paper manufacturing processes, was called in to help a paper mill out of a jam. Their calender rolls, the polished steel rolls that "iron" paper smooth, were corroding. Regrinding to polish the rolls was costly.

Mr. Thompson's on-the-spot investigation revealed that too much alum was being used in the sizing. Alum feed was reduced and the process water was treated with a glassy phosphate corrosion inhibitor. When reliable controls of the modified process were set up, corrosion disappeared.

Water Well Capacity Increased by Treatment With Glassy Phosphate

Initial capacity of new municipal well was recently increased 63% by treatment with Calgon.* Other new wells in the field developed capacity increases up to 34%. In an old well where the capacity had fallen to only 9.5 gallons per minute per foot of drawdown, one charge of Calgon raised the capacity to 31.2 gallons per minute per foot of drawdown, an increase of 228%.

In another case, after acid cleaning had restored a municipal well to approximately the same capacity it had when new, a single charge of Calgon raised the capacity by 100%, or about twice the original capacity of the well.

The dispersive action of glassy phosphate is responsible for its efficiency as a well cleaner. Cleaning with inhibited acid removes deposits of calcium carbonate and iron oxide, but will not affect accumulations of clay, quartz, amorphous silica, mica or silt. These latter are also dispersed and removed by Calgon cleaning.

Hall Is Water Consultant For Asia's Greatest Power Station

India's $35 million power plant, 200 miles north of Calcutta in the Damodar Valley, began operation in February. This is part of an extensive project to hasten the industrial development of a ¼-million square mile area of India.

Alex Henricks, staff engineer serving as consultant for India's new power plant, lifts water sample from container marked "This Package Opened and Examined by Customs at Calcutta."

Engineers and constructors of the station, The Kuljian Engineering Corporation of Philadelphia, have retained Hall Laboratories, Inc. as water consultants.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Don't waste it.

*Calgon is a registered trademark.

Dart Unions are leakproof because they're precision-machined to a true ball joint . . . then spherically ground for *wide*, true-bearing surfaces. If you want no leaks — you want Darts!

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- Extra wide bronze seats (Resist pitting and corrosion)
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DART UNIONS

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giving design details and explaining operation of each. Coppus Engineering Corp.

215 Oil Burning Equipment — Bulletin O-B 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows fuel oil pumping, heating systems. The Engineer Co.

216 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. National Airoil Burner Co., Inc.

REFRACTORIES, INSULATION

217 Refractory Cements — Sixteen-pp Form 863, presenting a line of refractory cements, discusses the three basic materials used in them, provides a detailed selection guide and illustrated discussion on methods of preparation and installation. Also defines terminology. Norton Co.

218 Heat Insulation Data — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Mundet Cork Corp.

WATER CONDITIONING

219 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques dicussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

220 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

221 Steam System Treatment — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (the Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing special chemical formulas for treatment of water, steam, brine and fuel. Western Chemical Co.

222 Boiler Scale — Formation and Prevention — Technical Paper 98 is a 12-pp article covering the cause and prevention of boiler scale. Covers the mechanism of scale formation, effect of boiler scale, chemistry of scale formation, internal chemical treatment and chemical correctives. Diagrams of feeder systems, pho-

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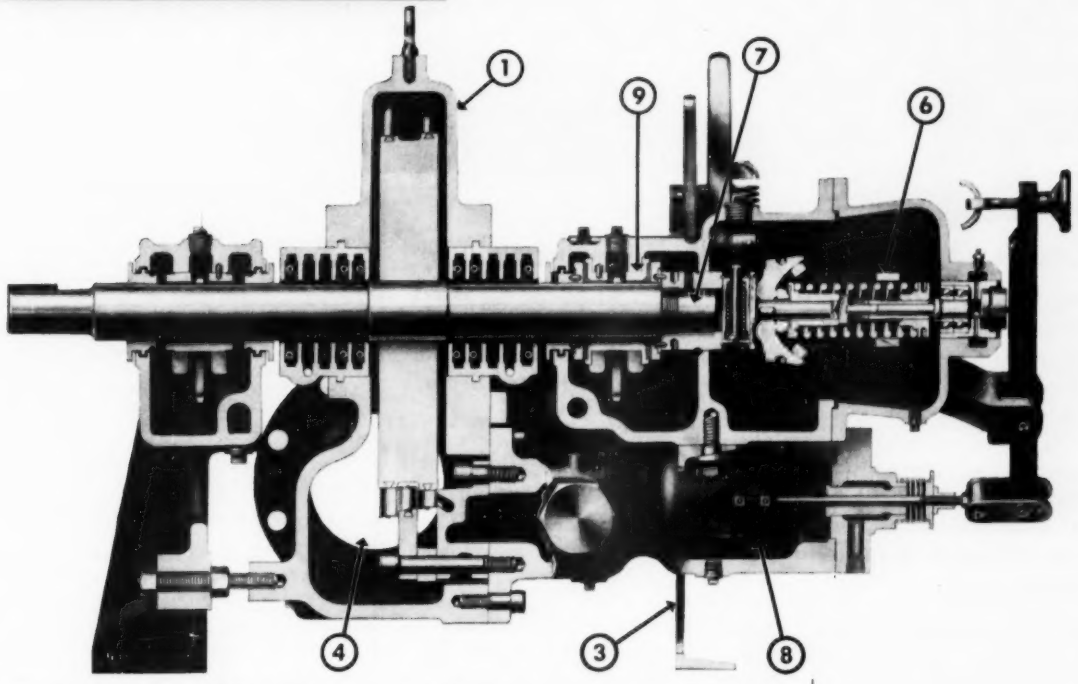

1 Case and Cover Split Horizontally on centerline for ease of maintenance.

2 True Centerline Casing Support assures distortion-free radial expansion. *Not shown.*

3 Flexible Support at governor end provides for axial expansion.

4 Exhaust Opening either right or left side for installation flexibility.

5 Steam Strainer, protecting trip and governor valves, is *removable* for cleaning without breaking steam connections. *Not shown.*

6 Constant Speed Governor features governor weights pivoted around frictionless surfaces.

7 Complete Governor Assembly is now *replaceable as a unit.*

8 Balanced Single Seated Main Governor Valve has proportional flow characteristics for sensitive, positive control.

9 Shaft Locating Bearing of adjustable double collar type.

Horsepower: 100 MAX
Steam Pressure: 300 PSIG MAX
Steam Temperature: 550F MAX
Exhaust Pressure: 25 PSIG MAX
Speed: 4,000 RPM MAX
Steam Inlet: 2"–250# ASA FLG.
Exhaust: 6"–150# ASA FLG.
Weight: 1,200 LB

Here's the new De Laval HCB Single Stage Turbine which is now "on the shelf" . . . ready for immediate shipment. This mechanical drive turbine is simple, rugged, designed for long economical life and low maintenance. For example, note the true centerline casing support, the replaceable governor, the removable steam strainer. Investigate all the advantages of this versatile driver. It is ready to handle—*at low cost*—a variety of applications in your plant.

Send for new Bulletin 4206
which gives vital facts and figures

DE LAVAL *Mechanical Drive Turbines*

DE LAVAL STEAM TURBINE COMPANY
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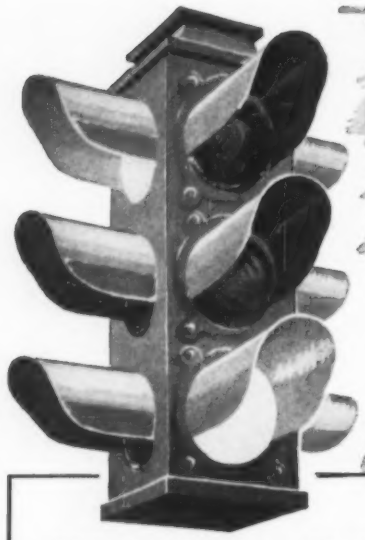

DRAFT FANS GO on GREEN

GREEN FANS . . . Used by Many Leading Utilities

One significant fact about Green Fan Installations at the New Orleans Public Service Plant is that two different boiler manufacturers were involved . . . two different types of boilers but Green Draft Fans for all three boilers. Each boiler has two Green Induced Draft Fans and one Green Forced Draft Fan.

When a concern has specialized on an important piece of power plant equipment for many years, that firm is rightly called the "authority" on the subject. This is the position of Green Fuel Economizer Co. in the field of mechanical draft fans. The name Green is synonymous with Draft Fans highly acceptable to industry.

The Line of Green Induced and Forced Draft Fans includes many types in many sizes which are described in Bulletin No. 168. We shall be glad to discuss your fan requirements with your own engineers, with your consulting engineers and with the boiler manufacturer of your choice.

THE GREEN Fuel Economizer COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

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tos and solubility charts illustrate text. W. H. & L. D. Betz.

223 Water Conditioning Data Book — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater make-up requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

224 Data on Zeolite Softeners — Publication 4520-A is a 32-pp well illustrated booklet on zeolite water softening. Provides a glossary of terms used in the process, data for laying out a zeolite softening plant, factors governing size of equipment, selection of Zeolite materials and discussion of the operating stages of a sodium zeolite softener. Cochrane Corp.

225 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

226 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and feedwater system, condensate returns. % Proportioneers, Inc. %

227 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

Postage-free cards for ordering these catalogs are on pages 37 and 136. When using them, don't forget to include your job title and company name—even if you want those catalogs to be delivered to your home address

228 Feedwater Treatment — Here is a 10-pp illustrated report on boiler feedwater treatment for a high-pressure, high-makeup power and steam producing plant. It is based on studies to determine best method of meeting requirements for both the high-pressure steam used in power generating turbines and the district heating steam for downtown Philadelphia. Graver Water Conditioning Co.

229 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary as-

"...On the feet of Individuals."

Society advances on the feet of individuals. We Americans live under the highest standard ever achieved because we believe in and are permitted currently to practice three of the cardinal principles of progress—Invention, Research and COMPETITION.

Nineteen basic inventions influence our pattern of life today. Each one was created to satisfy a fundamental need for improvement—a modern means of competing as against outmoded procedure. Each one, such as the electric light, the telegraph, the amplifying tube, the induction motor, created a new industry in which numerous companies strove in free competition for the maximum share of business.

For example, since Thomas Edison invented the incandescent filament lamp in 1880, the electric light industry has grown to an annual volume of $501,500,000 in light bulbs alone; in May, 1906 the Wright Brothers received the patent for their flying machine; the value of aviation manufactures in 1951 in the United States alone was estimated at $3,350,000,000 and in February, 1952, records show a $10½ billion backlog of orders.

More rapid still is the growth of the radio-television industry which today produces some $230 million worth of home radio sets and $1,570,800,000 in television sets. In every case, employment and sales volume grew enormously and the public enjoyed huge personal benefits.

Side by side with Invention came Research, exemplified by the competition of intelligent men questing for new materials, new methods, new processes, new scientific truths. Current advertisements tell of hundred-year tests to assure better materials for the future, technology that produces metals to withstand almost inconceivable heat, machines calculating 20,000 times faster than the mind of man, medicines that cure "incurable" diseases, food processes that cook, sterilize and pack hundreds of cans a minute. And in every case, the public enjoys huge personal benefits.

This is what James A. Decker undoubtedly had in mind when he wrote the line, "Society advances on the feet of individuals." These "individuals" are you and I, all our countrymen, benefiting every day from Invention, Research—and from COMPETITION.

Developing inventions, marketing products, and pursuing scientific research require substantial investments. A grave danger to their future now looms. In 1951, corporation net profits suffered a loss of 21% over the previous year. The reason—taxes too high, government controls and policies that interfere too greatly with private industry. If this continues, financial resources will dwindle, competition will be stifled.

Without free competition, American progress stops. No country can long exist when its government calls all the shots. We need competition to assure progress for people.

★ ★ ★

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Choose WESTERN
for Chemical Treatment of Water, Steam and Fuel

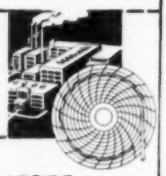
Look them over! Check your needs! Every Western product for treatment of water, steam or fuel is proved in use, technically formulated for each individual problem.

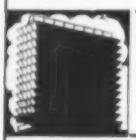
1 *Steam* + CORAVOL® = *Protection* (FROM CORROSION)

CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.

2 WESTERN BOILER FEED WATER TREATMENT

Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.





3 COOLING WATER TREATMENT AND ALGAECIDE

Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

4 BRINE AND SWEET WATER TREATMENT

Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

5 WESTO HOT WATER TREATMENT

Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.

6 WESTERN LIGHTNING TREATMENT

Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.

7 WESTERN ALUMINA NO. 45

Provides efficient coagulation in raw water ice manufacture, lime and soda softeners, water supply clarification.

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Removes and prevents soot deposits in combustion areas, thus increasing fuel economy and boiler capacity.

9 WESTERN FUEL OIL SLUDGE DISPERSANT

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pects of industrial water treatment. Wallace & Tiernan Co., Inc.

FUEL OILS, LUBRICANTS

230 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

231 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.

232 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

233 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

234 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc.

235 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

COAL, ASH HANDLING

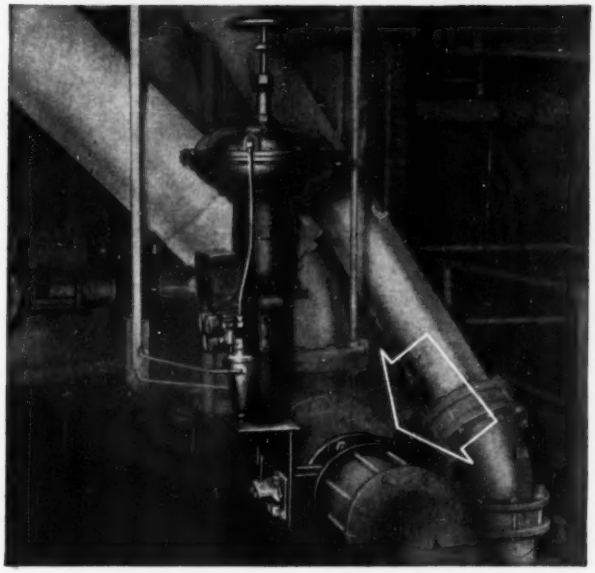
236 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. Detroit Stoker Co.

237 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; picture several models. Tractor Div., Allis-Chalmers Mfg. Co.

238 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven

R-S valv-Events

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •

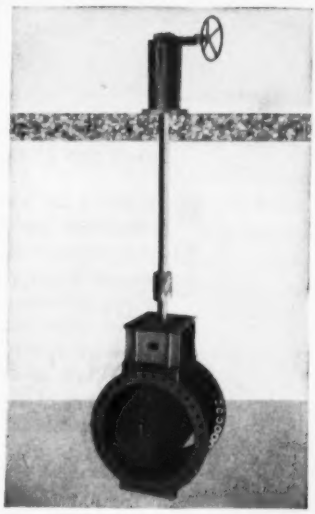


No. 677-A—1500-pound welding-end steel valve for superheated steam service. A. S. M. E. standards with heavy duty handwheel control.

R-S VALVE ADVANTAGES
Under Automatic Control

1. Wide range of throttling from open to closed position. 30 to 1 is standard. Minimum torque required for positioning.
2. Any type of instrument or control actuator can be used depending on preference and conditions. In any application, the R-S Valve usually costs less to purchase, less to install and results in lower pumping costs due to simplicity of design.
3. R-S Valve design offers no pockets to capture sediment, no change of flow-direction to create turbulence. Freedom from turbulence reduces erosion and cavitation and therefore adds to the life of the valve.

R-S Valves are used for regulation, pressure reduction, liquid level control, flow control, shut-off and other functional applications.



No. 864—50-pound valve equipped with rubber seat, extended shaft, thrust bearing, floor stand and heavy duty handwheel control.

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1. A 24" x 24" inlet opening and 26" wide belt for maximum coal flowability.
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6. No drag links or wires attached to weigh hopper.
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MATERIALS HANDLING BY WEIGHT SINCE 1902

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reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

239 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

240 Shredder Ring Crusher — A crusher for coal and similar materials which features rolling shredder rings is described in this 8-pp bulletin. Gives details on a survey of 29 mines and power plants in which this type crusher is installed. Informative tables giving speed, capacity, horsepower, weight and dimensions of crushers, as well as cost data are included. American Pulverizer Co.

241 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

242 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B; which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March.

HEAT EXCHANGING, COOLING

243 Heat Exchangers — The advantages of film-type heat exchangers in the solution of cooling water problems, even when dirty water must be used, are stressed in Bulletin HE-7, 8 pp. Explains and illustrates design details. Discusses use of these heat exchangers in power plants, chemical plants, and in a compression plant. Henry Vogt Machine Co.

244 Finned Tube Heat Exchanger — Bulletin 1400, 20 pp, fully describes the company's G-R Twin G-Fin Section heat exchanger. The unit has wide application for heating and cooling liquids and gases, and for condensing vapors, according to the company. Suitable as boiler feedwater preheaters, fuel oil heaters, etc., features of design and construction are given. Griscom-Russell Co.

245 Air-Cooled Heat Exchangers — Technical Bulletin R-53-DC1 is a 6-pp illustrated article on the economics of the air-cooled heat exchanger for process cooling. Discusses air-cooled exchangers and their selection, gives design details that affect cost and evaluates operating costs. The Marley Co.

PUMPS, PUMPING

246 Condensed Pump Data— Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature. Goulds Pumps, Inc.

247 Controlled Volume Pumps — Bulletin 351, 16 pp, describes company's

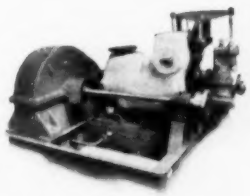
This diffuser-type valve gives Type M Turbine extra steam efficiency

This Westinghouse engineered diffuser is the key to achieving highest possible steam efficiency and accurate steam control in multi-valve turbines. The unique, long-diffuser design produces the lower pressure-drop effect of oversized valves. It does this by actually accomplishing a steam pressure recovery after the steam passes the valve seat. This pressure recovery means higher efficiency—*more production* per pound of steam.

Smoother steam flow is attained by the specially contoured valve head. Using steam vortex action, it centers precisely regardless of load, temperature or pressure variations. Result—*minimum wear* of valves and guides—long-term reliability and low maintenance.

These unusual design refinements which make such an efficient governing valve system possible can only come from a 50-year record of experience on turbines from 1 hp to the largest made. They are typical of the many Westinghouse improvements which have been combined with time-proved principles to bring industry its most flexible and modern line of general-purpose turbines. Get the full Westinghouse story *first*—to be sure your new or replacement steam drive has *all* the possible advantages for your particular operation. Call your local Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50559

TYPE M GENERAL-PURPOSE TURBINE



One of the many Type M applications, coupled to a reduction gear for industrial drive. It is a multi-stage, multi-valve type with ratings from 1000 to 10,000 hp and 1000 to 7500 rpm. Most advanced of all general-purpose turbines, it can be combined with a complete line of accessory equipment for every operating requirement.

Turbines for every industrial use

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Efficient

Illustrated is TYPE EMD Single Stage Blower (1) Fully enclosed motor. (2) Air straightening vanes. (3) Axial flow airfoil fan wheel mounted directly on motor shaft. (4) Blower mounted at this flange—no other support needed. (5) Voltrol Vanes. (6) Lever for capacity regulation. (7) Voltrol vane control mechanism.

WING

SINGLE STAGE and TWO-STAGE MOTOR-DRIVEN

FORCED DRAFT BLOWERS

WING Motor-Driven, Forced Draft Blowers are the result of years of pioneering with the airfoil design of the axial-flow fan. Each part of the Wing Blower is made to produce and control the air flow into the furnace for *maximum* firing efficiency. Sturdy construction, compact design, quiet performance, Voltrol Vanes, (permitting capacity regulation down to 10% of max.) plus low installation cost—are features of Wing Motor-Driven Blowers. Write for Bulletin SW-1a.

Wing

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air-powered controlled volume pumps, designed to pump practically any liquid in measured volumes accurate to within a fraction of 1 per cent. Pumps are reciprocating, positive displacement plunger types. Cross-sectionals show design and operating details. Controls and typical automatic feed systems are discussed. Milton Roy Co.

248 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

249 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data and vapor pressure tables included. Pacific Pumps, Inc.

250 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

PACKINGS, GASKETS, SEALS

251 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

252 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

253 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. Illustrated. Includes construction information, sizes. Johns-Manville.

254 Long Wearing Piston Packing — Form 4502, 8 pp, presents composition cups for packing pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature and pressure data, sizes. Darling Valve & Mfg. Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

255 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advan-

24 ACRES *Cover the World*

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VALVES, FITTINGS and FLANGES

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Air View of
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OUR COMPLETE LINE INCLUDES

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Trying to reduce piston packing maintenance?

J-M Pump Cups after removal from feed water pumps at Morgan Laundry. Set above consists of 2 J-M "A" Cups with spacer and 2 followers, mounted on pump rod

At the Morgan Laundry, J-M Moulded Packings provide

"8 times longer life— replacement in 1/6 the time"

THE MORGAN LAUNDRY, large supplier to hotels and institutions, requires dependable, trouble-free service from boiler room equipment. In their New York City plant, the Engineering Department found that conventional piston packings for boiler water feed pumps lasted only a relatively short time. Many hours of down time were required to replace packings. Liner wear became progressively worse.

When the Engineering Department changed from the conventional material to J-M Moulded Packing Cups, service life of the packing was increased more than 8 times. Liner wear was greatly reduced. Replacement with the new packings was made in 1/6 the time. Packings could be easily installed for proper service, without special skill or experience. Satisfaction with this application has led to the use of J-M Moulded Packing Cups on other boiler room equipment and on presses in the Morgan Laundry plant.

These precision moulded packings offer definite advantages over conventional types. Because they form a highly efficient seal, they contribute to improved performance, lower operating and maintenance costs. For steam pump pistons, they are available in sets consisting of two cups and two followers, with a spacer. This pump cup set, J-M Style 80, is similar to that shown in the illustration above.

Your Johns-Manville Packings Distributor can help you make the right selection for your application, from Johns-Manville's line of custom-made Piston Packing Cups. For complete details write him or Johns-Manville, Box 60, New York City 16. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

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tages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

256 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, also provides tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

257 Valve Specialties — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

258 For Quick Valve Selection — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and indexed, includes pressure-temperature chart. The Ohio Injector Co.

259 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

260 Cast Steel Valves — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

261 Gate Valves — Literature is available on cast steel outside-stem-and-yoke gate valves; also on bronze, iron, steel and corrosion-resisting valves in a variety of types. The Wm. Powell Co.

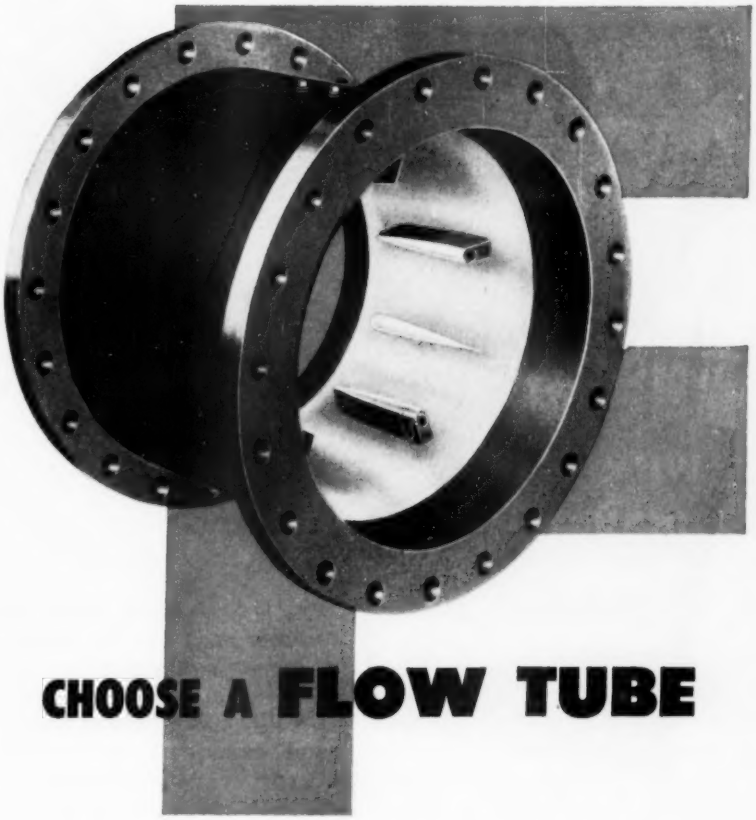
Postage-free cards for ordering catalogs and bulletins are provided on pages 37 and 136

262 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

263 Regulating Valves — Bulletin 313 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured body engineered for high capacity at low pressure drop. Leslie Co.

264 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full

WHERE HEAD LOSS IS IMPORTANT



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The Flow Tube is available in types and D/d ratios to handle a wide range of fluids and main line velocities. This flexibility enables you to use the one Flow Tube that will produce differentials that can be accurately measured, with the least head loss.

Flow Tubes have many other plus values—they're compact, comparatively light weight, and are easy to install since they require minimum straight runs entering and following. All Flow Tubes are furnished with head-capacity curves obtained in laboratory tests and can therefore be guaranteed as to accuracy.

That's why Flow Tubes are being successfully used in scores of installations metering the flow of liquids and wet or dry gases. Available in all pipe sizes and suitable metals. They can be furnished with or without suitable secondary indicating, recording or totalizing instruments. For further information, write for Bulletin FT102. For specific recommendations, send us necessary flow data.

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Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere-and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE

regardless of the source. Chlorination helps reduce slime in make-up or cooling water.

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selection and ordering data, materials of construction, sizes. Describes manuals and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages of the valves are discussed. R. S. Products Corp.

265 Solving Steam Trap Problems — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

266 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

267 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring Co.

268 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp., provides capacity tables, installation, diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb, expansion steam traps, weight-operated traps for steam, air and gasoline, also piston-operated traps. W. H. Nicholson & Co.

269 Data on Strainers — Several types of pipe line strainers for all purposes in sizes from ½ to 36 in. are described and illustrated in 16-pp Manual 951. Summarizing important developments, booklet carries information on factors to consider in selecting a strainer for a specific application. J. A. Zurn Mfg. Co.

270 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

271 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

272 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

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The man with an objective is a better employee. He knows that a day lost from work is just that much out of his take-home savings. He doesn't take chances—wants to stay off the accident list. He has a new realization that better work on his part will lead to advancement—and a larger monthly allotment for Defense Bonds.

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ELECTRICAL

273 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is provided. Westinghouse Electric Corp.

274 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. United States Rubber Co.

275 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

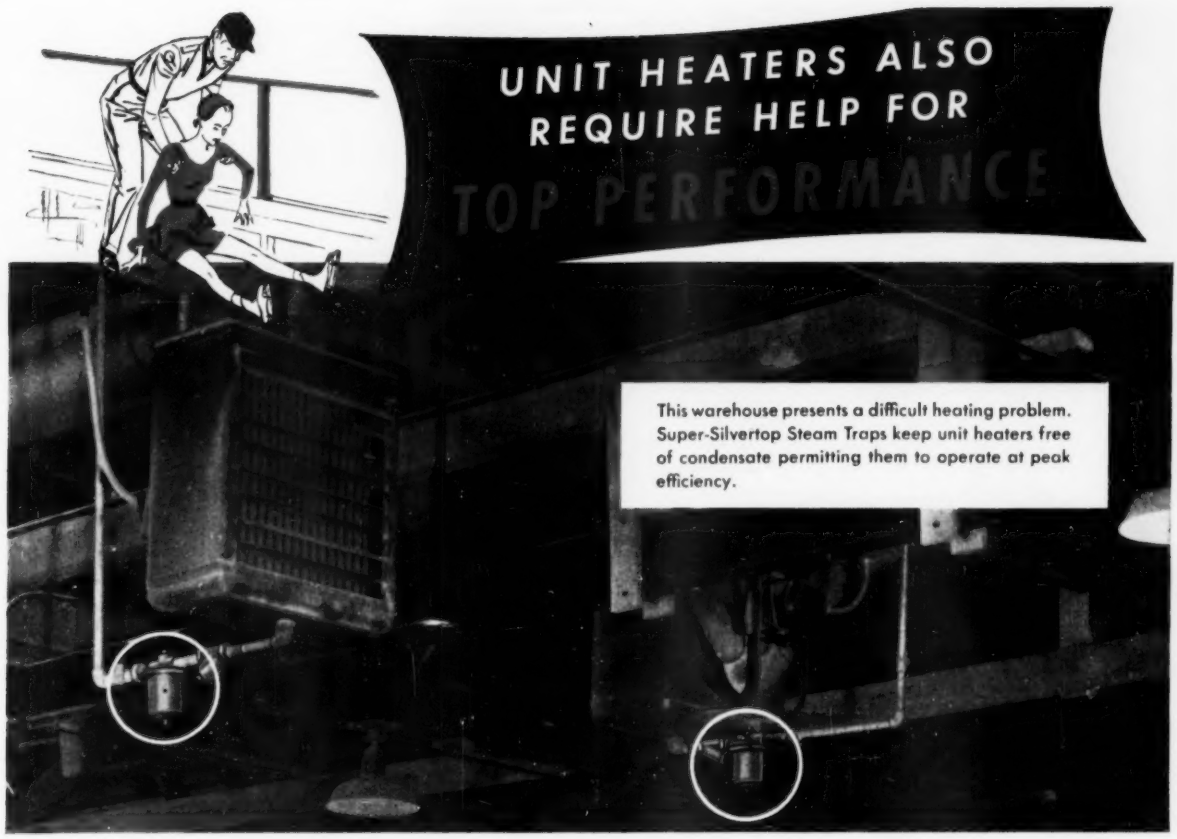
276 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

277 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

278 Meet Microwave — "An Introduction to Microwave," 20 pp, provides a semi-technical description of RCA microwave equipment and is illustrated with photos, charts, diagrams, etc. Describes microwave radio, tells how it works, gives propagation characteristics, operational advantages, economic factors influencing choice of frequencies, and desirable design characteristics. Also deals with multiplexing, telemetering and remote control features. Microwave Communications Section, Radio Corp. of America.

INSTRUMENTS AND CONTROLS

279 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in gen-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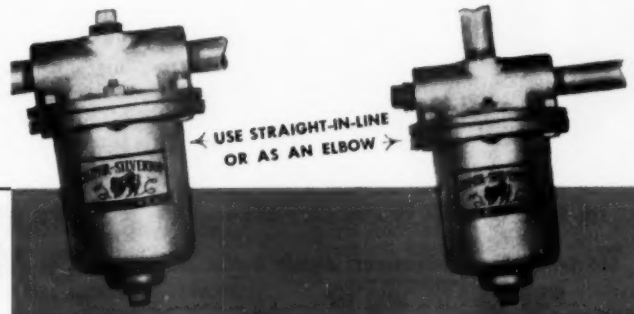

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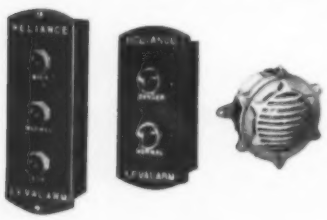
EA-114 operates alarms for high or low water and cuts off fuel when water is either too high or too low.

Installed in a dependable Reliance float-operated Alarm Water Column, EA-11 Levalarm gives you a sensitive efficient *compact* device for safer supervision of water levels. Two-light and three-light Indicators, and Vibratory Horns, illustrated at left are available from Reliance. Full wiring instructions are supplied for connecting one or more alarm devices to the Levalarm. Write for full information — or call your Reliance Representative.



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erating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

280 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls. Republic Flow Meters Co.

281 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

282 Control Centers — This 31-pp application booklet (B-5621) on control centers stresses the case for centralizing all controls of an entire system in one group of enclosures. Discusses the characteristics of control centers that make for flexibility of use, ease of servicing, safety. Three types are described, and the various electrical components that make up typical units are illustrated. A three-step building-block system of planning control centers is given. Westinghouse Electric Corp.

283 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Description of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

284 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information and company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

285 How to Select Regulators — This 36-pp, illustrated "step selection chart" simplifies choice of proper type and size of pressure regulator, temperature regulator or pump governor to do a specific job. Written in nontechnical language and supplemented by steam, gas and water capacity tables, this booklet includes installation suggestions, conversion tables and other data. Foster Engineering Co.

286 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature, instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

287 **Pneumatic Valve Operator** — This 8-pp bulletin explains operating principles and outstanding features of the Rotomotor positioning operator for throttling control service. Tells how this heavy duty, all-pneumatic operator is designed to combine safety and economy of air operation with the power of a gear driven screw stem. Conoflow Corp.

288 **Electronic Feedwater Control** — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

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289 **Boiler Control** — Ten-pp Bulletin 1007 describes a completely integrated system for controlling combustion, feedwater, boiler steam temperature and boiler cleaning, available in a single package or furnished separately. Illustrated with full color drawing of complete control, photos of recorders, drive unit. Covers instrumentation with both miniature and standard instruments. Copes-Vulcan Div., Continental Foundry & Machine Co.

290 **Easy Reading Gage** — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

291 **Gage Cocks** — Quick-opening and self-closing gage cocks in models designed for pressures up to 250 lb and 450 lb, and a wood wheel gage cock designed for pressures up to 150 lb are described in this illustrated folder. Explains construction, applications. The Paul B. Huyette Co., Inc.

292 **Pressure Regulator** — Bulletin 1-B, 8-pp, discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for back pressure relief valve. Atlas Valve Co.

OTHER EQUIPMENT

293 **New Engine Developments** — Bulletin S-500-B-55, 12 pp, presents new developments in oil diesel, dual fuel diesel and high compression spark ignition engines. Describes features of modern, economical, heavy duty, internal combustion engines. Includes a heat balance chart showing waste heat recoverable from exhaust gases and jacket cooling water;

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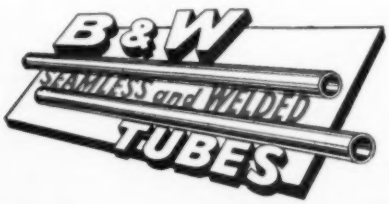

TA-1794(A)

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and is accompanied by fuel cost charts and descriptions of installations utilizing heat recovery systems. Engine Div., Worthington Corp.

294 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings. Elliott Co.

295 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. Also discusses other advantages, including eliminating need for tall stacks. L. J. Wing Mfg. Co.

296 Why Fully Crowned Teeth — Seven major engineering advantages of fully crowned teeth in gear type flexible couplings, are described in Bulletin 1052. Applications of Amerigear couplings for the solution of power transmission problems such as excessive offset or angular misalignment and space limitations described. American Flexible Coupling Co.

297 Hydraulic Equipment — Circular 50-A, 6 pp, describes and pictures hydraulic jacks, hydraulic high-pressure and test pumps, and hydraulic units for forcing, pressing, pulling etc. Includes application suggestions, material specifications, capacities. Richard Dudgeon Inc.

298 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

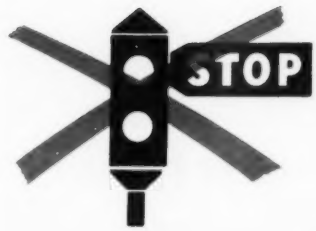
299 Chemical Cleaning Service — Reduced maintenance costs and outage time are among advantages of company's chemical cleaning service for steam equipment and water lines discussed in this 8-pp bulletin. Before-and-after photos show some actual cleaning jobs. Dowell Inc.

300 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. The Green Fuel Economizer Co., Inc.

301 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

302 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures. Foster Wheeler Corp.

303 Air Preheaters—Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Describes company's Ljungstrom preheater. The Air Preheater Corp.



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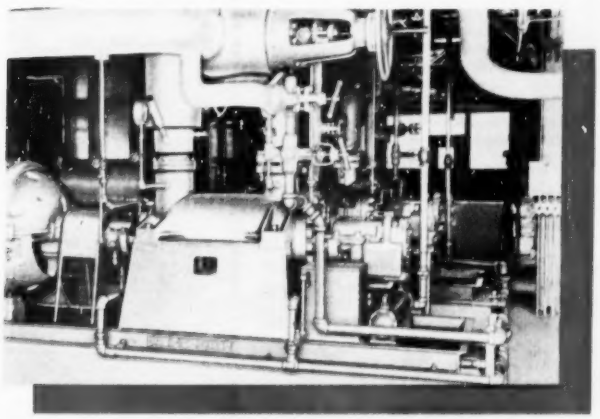
Electric power generation and transmission are geared to continuous, indefinite operation. A vital link in keeping this electrical energy on the GO is Pacific boiler feed pump installations – both operating and standby. For more than two decades, Pacific has built feed pumps for this exacting service in central stations and industrial power plants on four continents.

Sizes installed range from the midgets of less than 50,000 lbs. per hour to the giants having a capacity of 1,000,000 lbs. per hour. The operating discharge pressures range from 200 to 2500 psig. More than 50 units are operating at discharge pressures above 2000 psig.



To insure GO in your central station or industrial power plant, specify boiler feed pumps by Pacific Pumps, Inc. For more information, write for Bulletin 109.

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Close-up view of leaf-type filter used with Sorbo-Cel by Pullman-Standard

How Pullman-Standard operates boilers on a

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At the Haskell & Barker plant of Pullman-Standard Car Mfg. Co., Sorbo-Cel solved the major filtration problem of removing oil from condensate returned to the two new 50,000 lb-per-hr 400 psi, 750-F boilers.

Pre-Coat Sorbo-Cel and regular Sorbo-Cel, specially processed high flow-rate diatomaceous silica powders, are used on leaf-type filters. After a film of Pre-Coat Sorbo-Cel has been built up on the filter screens, regular Sorbo-Cel is added continuously to the unfiltered water. This means a new filter surface is constantly presented to the oncoming water.

Results . . . Water filtered by Sorbo-Cel contained less than 0.1 ppm of oil . . . and boilers have since been operated on a *one per cent* blow-down basis.

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Obituaries

Arthur R. Borden

ARTHUR R. BORDEN, 53, manager for the past 12 years of the Detroit branch office of Hagan Corp., Pittsburgh, Pa., died at his home in Detroit last July following an extended illness.

Surviving are his widow, Mrs. Gertrude Ormiston Borden; son, Arthur R. Borden, Jr.; daughter, Miss Lou Ann Borden, and uncle, Carlos E. Sperry.

Mr. Borden, who joined Hagan Corp. in 1926 as a sales engineer, was graduated from Pennsylvania State College in 1918 with the degree of bachelor of science in mechanical engineering. Before becoming associated with the Hagan Corp., he had been employed by Crucible Steel as an operating engineer, and later by Duquesne Light Co. of Pittsburgh, at its Colfax Station, in the same capacity. After several years in the Pittsburgh office, Mr. Borden was sent to Birmingham, Ala., as manager of Hagan's office there. He returned to Pittsburgh after four years and later was assigned to the Detroit office.

Inward Flow Turbine

(*Continued from page 85*)

At constant rpm in a fixed-blade wheel, the flow path through the wheel is dependent on the inlet velocity (head and/or flow). Changes in the flow path resulting from constant rpm operation under varying load (thereby under varying head and/or flow) can cause the leaving water to strike the shaft (if a through-shaft machine) or impinge on the inner edges of the blades in such a manner as to retard the wheel rather than drive it. Internal flow guides should be simple to install, thereby assuring a fixed path at all flows and/or heads. This one improvement would broaden the application of the turbine considerably.

Industrial Hydraulics Conference

NATIONAL CONFERENCE on Industrial Hydraulics, 9th Annual Meeting, will be held Oct. 8 and 9 at Hotel Sheraton, 506 N. Michigan Ave., Chicago.

Program includes papers on automotive, press, aircraft, machine tool and tractor hydraulics. Industrial non-flammable fluids, components, and instrumentation are also covered. Full information on program and registration from John G. Duba, Conference Secretary, National Conference on Industrial Hydraulics,

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BELMONT 19 . . . for hot and cold water rods and plungers; low and intermediate steam rods.

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Don't make do with the next best—*insist* on BELMONT . . . available in a wide range of materials . . . hundreds of styles and types . . . through distributors everywhere.

For technical assistance on packing specifications, write direct—ask for Catalog #40 or detail your particular problems. 4-M-1A

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Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

ASME Fall Meeting at Rochester

FALL MEETING of ASME will be held October 5, 6 and 7 at the Sheraton Hotel, Rochester, New York, with the cooperation of the Rochester Engineering Society and the Engineering Institute of Canada.

Technical sessions will cover: machine design; production engineering; metal processing; power; fuels; heat transfer; management; education; instruments and regulators.

In the power and fuels sessions, data will be presented on design and operation of Russell Station and Dunkirk Station, on coal and ash handling features of Milliken Station, on gas and petroleum fuels. Design of Kodak Park's power system will be covered, also operation of air preheaters and boiler feed pumps.

J. Foster Petree, editor of *Engineering* (London) will deliver the Calvin W. Rice Lecture and Col. Carey H. Brown of Eastman Kodak Co. will deliver the Roy V. Wright Lecture.

Inspection trips to Kodak Park, The Pfaudler Co., Russell Station and Mixing Equipment Co. are scheduled. There will be luncheons each day and a banquet on Tuesday evening, October 6.

Correction Note

IN THE September issue, the title of the article by Herbert B. Reynolds on page 102 should have read: Cost Comparisons of Small Steam Turbine and Oil Engine Plants (instead of Parts). If you read the subtitle, you probably suspected something wrong here. Our humble apologies.

16th Annual ASME-AIEE Fuels Conference

AMERICAN Institute of Mining and Metallurgical Engineers and the American Society of Mechanical Engineers will hold their annual Joint Fuels Conference in the Grand Ball Room of the Conrad Hilton Hotel, Oct. 29 and 30.

The program covers major developments in the fuels field and will summarize the midwest oil, gas and solid fuels situation in a comprehensive way. Included will be discussions of germanium in coal ash, reduction of moisture in washed coal, heat drying of coal, and developments in mining.

Luncheons and a banquet will be held. Full information can be obtained from ASME headquarters, 20 W. 39th Street, New York 18, or from AIME or ASME Chicago Section headquarters, 84 E. Randolph Street, Chicago, Ill. For AIME, Carl T. Hayden is chairman; for ASME, John R. Michel, Commonwealth Edison Co., 72 West Adams St., Chicago, is co-chairman.

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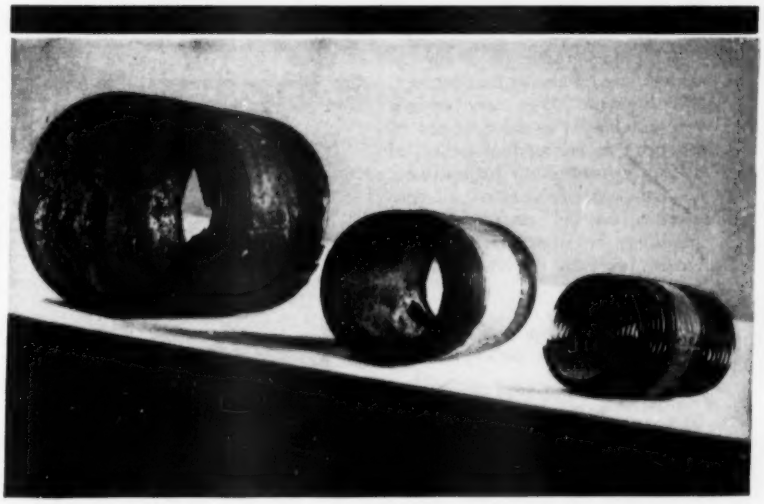
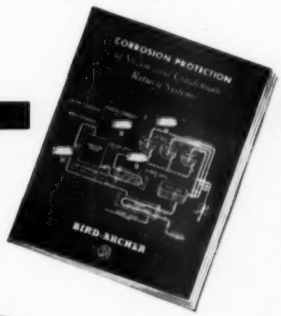
with BIRD-ARCHER AMINE TREATMENT



Unretouched photograph shows the ravages of corrosion on condensate return lines.

Corrosion of piping in steam and condensate return lines is an expensive two-way headache. (1) It leads to large outlays for pipe replacement and maintenance. (2) It often results in plugged return lines and traps due to the solid products of corrosion. Bird-Archer Amine Treatment effectively eliminates these troubles at low cost.

Here's how. Amines are fed into the boiler or into the steam and condensate systems. The amines raise the pH value of the condensate and also tend to inhibit equipment-destroying corrosion through surface protection of the metal itself. In scores of plants, this Bird-Archer system has more than paid for itself by substantially cutting replacement and maintenance costs.



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Bulletin CP 100 gives all the facts on Bird-Archer Amine Treatment. Write for your copy.

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Solve Sludge Problem with Nicholson's *New* AIR TRAPS

With the introduction of an exclusive new oil-eliminating feature, Nicholson air traps now enable you to enjoy the advantages of the positive intermittent action of a float-operated air trap without the common problem of oil congealing on the mechanism and impeding or stopping its action. Other features of Nicholson air traps:

1) No air-wasting vent, such as is in all inverted bucket traps.
2) Positive water seal of valve.
3) Large orifice keeps valve clean, preventing blow-through.

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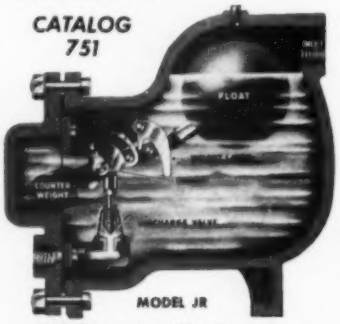

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Sulphated Batteries

(*Continued from page 108*)

reaches 1.80 and from then on at 15 minute intervals. From this point on the cell voltages should be under constant observation and the time recorded when each cell voltage goes below 1.75 volts. Terminate the test discharge when the majority of the cell voltages reach 1.75 volts, but stop the test before any single cell goes into reversal.

6. If the battery gives rated capacity no further treatment is required other than normal recharge and equalization of gravity.
7. If the battery does not deliver near-rated capacity, continue the discharge without adjusting the discharge rate until one or more cells reach 1.0 volts.
8. Recharge battery at the finishing rate as described above, again charging until there is no further rise in specific gravity over a 4-hour period, readings being taken hourly.
9. Discharge again at the 8-hour rate and if the battery gives full capacity, recharge and put into service.
10. If this procedure does not result in full capacity, repeat once more as noted above.
11. If battery does not respond to this treatment, it is sulphated to the point where it is impractical to attempt further treatment and battery should be replaced.

New ENGINEERING BOOKS

Basic Mechanics of Fluids, by Hunter Rouse and J. W. Howe; 238 pages, illustrated; size 5½ x 9 in., cloth binding. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y.; 1953. Price $4.50.

Dealing specifically with the *mechanics* of fluids, this undergraduate text book attempts what often is termed an impossibility — formulation of a course in a division of engineering mechanics within the grasp of the average junior student.

Here the authors apply the basic principles of kinematics and dynamics to the elementary motion of a fluid, with the effect of each essential fluid property studied in turn. The attempt is made to realize the general methods of analysis, rather than isolated procedures for solving particular problems.

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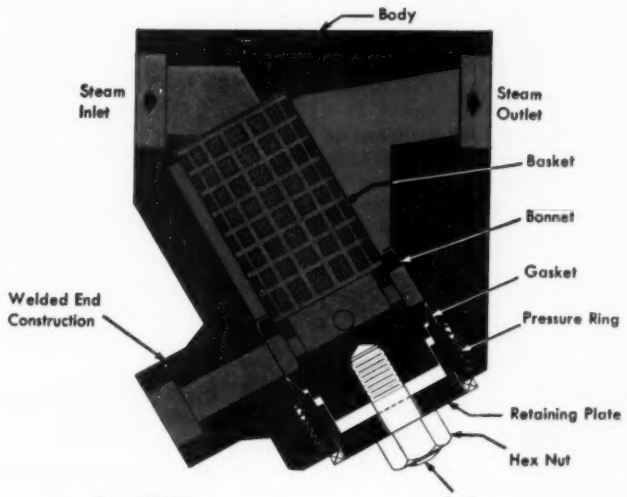

Fig. 994-HP

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The strainer, designated an *SK Fig. 994-HP Strainer*, features a forged steel or alloy body and "pressure seal" bonnet construction. The "pressure seal" joint, see Fig. 994-HP and note above, eliminates the excessive bulkiness of a flanged, bolted cover which, at higher temperatures and pressures, necessitates the use of large studs and nuts and unnecessarily large over-all design. As shown, the "pressure seal" design is compact with minimum face to face dimensions.

The basket is rolled from perforated or drilled plate which, when required, serves as backing for a fine mesh screen. The blow down connection has been brought through the side of the strainer wall. This design feature means that no piping need be broken when removing the cover and strainer basket from the body for maintenance, checking, or replacement. This factor is particularly advantageous at high pressures and temperatures where pipe joints are usually welded.

SK Fig. 994-HP Strainers are made in any size required by the application. At present, no other literature is available, however, if you have any questions, write to us at the address below and our engineers will reply at once.

***NOTE:** Schutte and Koerting Company is one of the pioneers in the development of pressure seal joint construction in the United States having first experimented with this design in 1938. As shown in Fig. A (detail drawing of the "pressure seal" gasket) practical experience and research have resulted in a successful design wherein the gasket angle is relatively narrow and the gasket has been completely plated with a metal coating. The sharp gasket angle is of particular importance in small diameter pressure seal joints where the ratio of linear circumferential length of the gasket tip, which must be expanded, to the pressure area of the small diameter cover, is relatively high. The thin metal coating material is of a non-corrosive "lubricating" nature and is satisfactory for high temperature service while being soft enough to deform, under pressure, and fill minute irregularities in the body bore and cover gasket face. The base metal of the ring, under the coating, meets rigid specifications of dead soft anneal and dimensional tolerances. Note, also, that the body counterbore diameter is increased just below the gasket. This eliminates the necessity for drawing the gasket out through a long, close diameter bore and makes disassembly easy.

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vide as great a diversity of interest as possible. In all of these, students will find proof of the convenience of dimensionless notation.

All 30 sections of the book can be covered readily in a semester course. While the authors grant the instructor's prerogative of skipping as many sections as he desires, they have tried to include, however slightly, all material they believe the undergraduate engineer should know. They believe that learning to use the same method to solve different problems will prove helpful to the general student.

Hunter Rouse is professor of fluid mechanics at the State University of Iowa, and has directed the Iowa Institute of Hydraulic Research since 1944.

J. W. Howe is professor and heads the department of Mechanics and Hydraulics at the same university, and is consulting engineer of the Iowa Institute of Hydraulic Research.

* * *

Ultraviolet Radiation, by Lewis R. Koller; First Edition; 270 pages; 6 by 9¼ in.; illustrated; cloth; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.; 1952. Price $6.50.

This book partially fills a need for a comprehensive source of information and data on ultraviolet radiation. As the author points out in the preface of his book, there is a wealth of information available in the scientific and technical literature covering every aspect of ultraviolet radiation, but this information is scattered and it is difficult for the non-specialist in the field to find the information he requires at the time he needs it. This book is intended to answer some of the questions which confront physicists and specialists in fields other than physics when they find it necessary to work in the ultraviolet portion of the spectrum.

The author does not make the slightest pretense at being comprehensive or all inclusive, but he does treat of those matters which are of most importance to people who are attempting to utilize radiation at the shortwave end of the spectrum. Dr. Koller is a Research Associate at the General Electric Research Laboratory in Schenectady, and his book is the result of his considerable experience in the field. The book should be particularly valuable to those who have to use ultraviolet equipment, but who are not necessarily specialists in the field.

* * *

Harmonics, Sidebands and Transients in Communication Engineering, by C. Louis Cuccia; First Edition; 465 pages; 6¼ by 9¼ in.; cloth; published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y.; 1952. Price $9.00.

This is a highly specialized book for those conversant with the more profound aspects of communication engineering and who have the mathematical training and knowledge necessary to assimilate the subject matter. In other words, it is not a book for a novice or one who is concerned with the practical aspects of communication engineering. At the same time, it is a highly useful book to those who have the proper background.

* * *

A Course in Electrical Engineering, by Chester L. Dawes; Vol. I, Direct Currents; Fourth Edition; 736 pages; illustrated; 6½ by 9¼ in.; McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y.; 1952. Price $7.00.

This new edition of Professor Dawes' book provides the student who is beginning the subject of electrical engineering with a course which includes both theory and practice in the field of direct current. In general, the book covers electric circuits and circuit theory, primary and secondary batteries, electrical instruments and measurements, magnetism, electrostatics and the dielectric circuit, electrical machinery and direct-current power transmission. Each subject is developed from fundamental relations and carried to a level which is sufficiently advanced for most undergraduate curricula.

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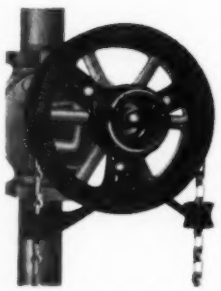

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specialize in electrical engineering but who need a certain amount of electrical knowledge. Such men often find difficulty in obtaining detailed and straightforward discussions of the subject in any one text. Men taking foremen's and industrial evening courses need textbooks sufficiently comprehensive, but at the same time not involving much mathematical analysis.

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C.R.S.I. Design Handbook. Size 6 by 9 in.; 412 pp; illustrated; cloth bound. Published by Concrete Reinforcing Steel Institute, 38 So. Dearborn St., Chicago 3, Ill. Price $5.00.

Here is a guide that can streamline computations for reinforced concrete jobs. It is not intended as a substitute for the judgment of experienced engineers. However, the book offers time cutting assistance in the form of its tables, diagrams and formulas. Even though the book mainly presents finished design information, consideration is given those who wish to do their own computation in thorough complementary technical content.

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Thirty-three suggestions for making drawings of reinforced concrete structures are included in this book along with suggestions on standard design details. Trigonometric tables and engineering unit conversion factors appear in the back portion of the book.

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Measurement Techniques in Mechanical Engineering, by R. J. Sweeney; 309 pages including index; illustrated; size 6 by 9 in.; cloth bound. Published by John Wiley &

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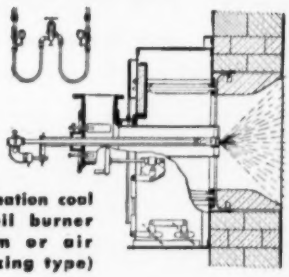

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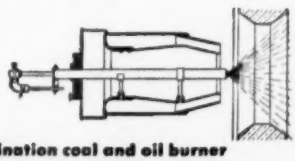

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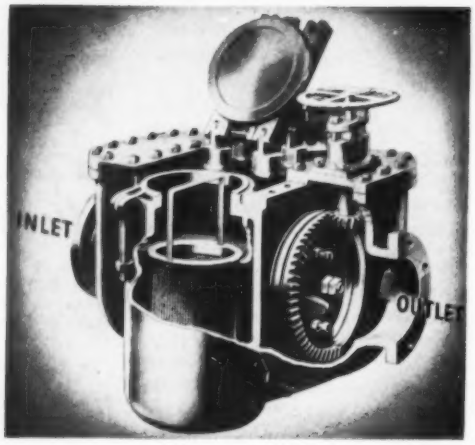

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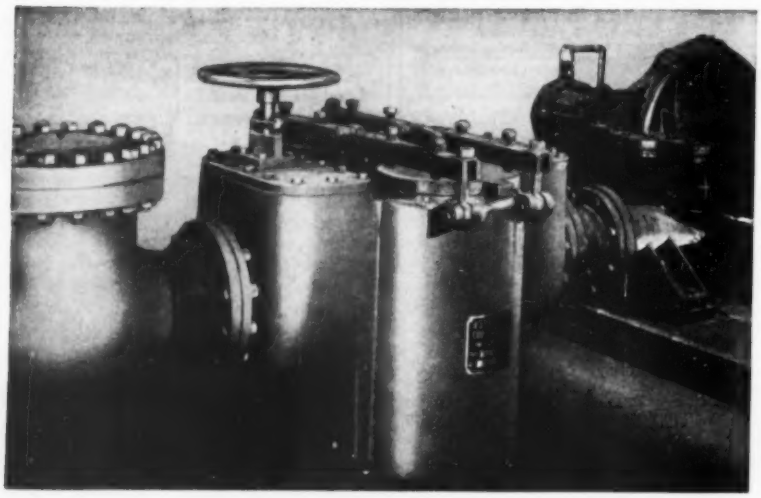

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Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $5.50.

This book brings together a wealth of information on measurement instruments and techniques and relates them to control systems and measurement problems. The capabilities of each instrument or technique is evaluated in such a manner that trial-and-error is strictly minimized. It would take a practicing engineer years to accumulate this much factual data in the normal course of his work. Careful organization has increased its value as a reference for designers and supervisory personnel.

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Refrigerating Data Book, Applications, Fourth Edition, by various authors; 750 pages; illustrated; size 6 by 9 in., cloth binding. Published by the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18, N. Y. Price $7.50.

This volume is one of a continuous series of books published by the Society since 1932. The early Refrigerating Data Books covered both applications and design data, but later they were separated into two books.

For the industrial power engineer, this volume on Applications of Refrigeration can be extremely useful, not only in giving him data on his own industry's use of refrigeration, but presenting principles and applications used in other industries that he may be able to adapt to his own uses.

Since a great deal of refrigeration machinery is used for the preservation of food, the first four sections of the book are the largest and cover Frozen Foods, Refrigeration in Food Manufacture, Refrigerated Warehouse Practice, and Refrigerated Food Distribution.

These are followed by sections on low temperature applications, industrial applications, comfort air conditioning and industrial air conditioning.

The power engineer doubtless will be interested first in the industrial applications which cover ice manufacture, skating rinks, refrigeration in construction work (for example, the use of refrigeration in construction of dams), refrigerated pipe lines and cooling of electrodes in welding.

The section on Industrial Air Conditioning, also, contains a great deal of valuable information on practical uses of refrigeration, not only in air conditioning and processes but in precision manufacturing, laboratories, printing plants, textile plants and hospitals.

The present fourth edition has been revised in the light of the latest technological developments in that field, especially the wider use of low temperature refrigeration.

At the end of the book is a comprehensive directory of refrigeration and air conditioning equipment manufacturers together with their advertising. The editorial section of the book is well indexed.

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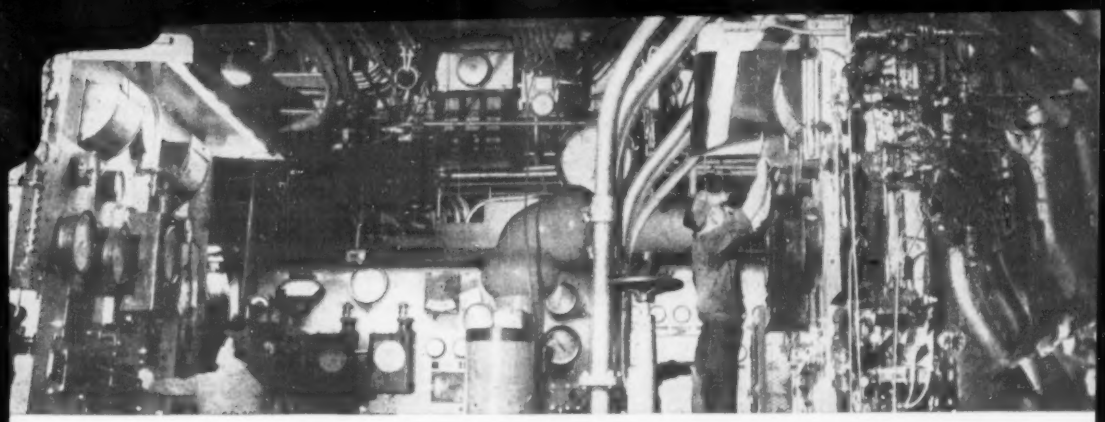

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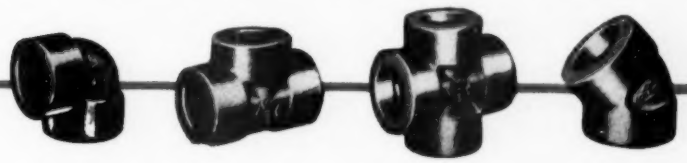

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pronounced "core"

A PROCESS OF ELIMINATION

OF SLUDGE, RESIDUAL DEPOSITS INCLUDING
SLAGS OF ALL KINDS AND GUMMY SOOT

IN OIL-FIRED FURNACES AND BOILERS WHICH MAKES MORE STEAM POSSIBLE WITH LESS FUEL

PAYS FOR ITSELF TIME AND AGAIN BY THE FUEL IT SAVES

Liquid KOR by nature is ALKALINE (non-acid, non-corrosive) and is one fuel oil conditioner really safe to use; yet it's so powerful it dissolves asphalt sludge found in petroleum pitch, which fact alone proves it will do a job 6 times harder to do than any sludge-dissolving, fireside and fuel system cleaning job you are confronted with in burning today's modern fuel oils.

Write for Prices and Free Bulletins

KOR CORPORATION
Division of Oxi Corporation
MANUFACTURING, ENGINEERING, AND COMBUSTION SPECIALISTS
600 WEST 9th AVENUE, GARY, INDIANA

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Sign Your

DECLARATION OF INDEPENDENCE

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Buy U. S. Savings Bonds!

HOW TO ROLL BOILER TUBES

You can count on smooth, efficient rolling action, which assures firm seating of the tube from precision-made Wilson Tube Expanders. They provide perfectly rolled joints, reduce time wasting re-rolling and re-inspection.

Wilson Model 38 Tube Expander— Popular, parallel, expansion flaring and rolling tool for high pressure boiler tubes, superheaters, economizers and marine steam generators. They do both rolling and flaring in a single operation . . . are available for tubes 1″ OD to 4½″ OD with various rolled lengths for tube sheets a half inch and up in thickness. Write for Bulletin 380A.

Wilson Accessories — Various boiler-maker accessories are in stock such as right angle worm drives, gear trains, extensions, universal joints in standard size squares, etc. Look to Wilson for a complete line of modern expander tools.

Wilson Tube Cleaners make short work of the toughest deposits. Driven by air, water, steam or electricity, these high speed tube cleaners can be furnished in straight or curved, ferrous or non-ferrous from ⅜″ to largest ever cleaned. Write for Bulletin 47A.

Representatives in all principal cities
THOMAS C. WILSON, INC.
21-11 44th AVENUE, LONG ISLAND CITY, L. I., N.Y.
Cable address: "Tubeclean" New York

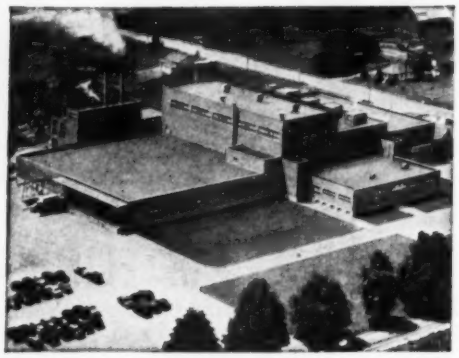
WILSON TW-883
TUBE CLEANERS • TUBE EXPANDERS

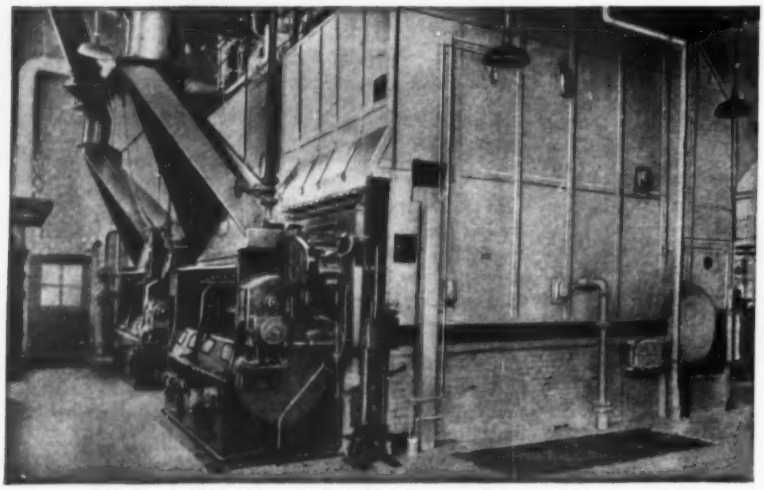
For more data circle 602 on Post Card

"COAL'S BEST FOR OUR MODERN PLANT!

It's low in cost . . . It's clean and convenient!"

says G. W. Peters, Engineering Manager
M&R DIETETIC LABORATORIES, INC.
makers of PREAM & SIMILAC





"We made a careful study of fuels and burning equipment before building our modern new plant in Sturgis, Michigan. This plant was designed to produce baby food. So the steam plant has to be clean and dust-free as well as economical to operate. Also, we wanted a fuel we could store safely and easily in order to insure ourselves against any shortages.

"We decided on bituminous coal—and the up-to-date installation shown here. It certainly fills the bill on every count. Our modern combustion equipment makes coal far more economical than any other fuel. Up-to-date coal and ash handling give us convenient operation completely free of dust nuisance."

Additional case histories, showing how other types of plants have saved money by burning coal the modern way, are available upon request.

Discover for yourself the great advantages of coal burned the modern way. Call in a consulting engineer. He'll show you how today's combustion equipment can give you 10% to 40% more power from a ton of bituminous coal than from equipment used only a few years ago. He'll show you how modern labor-saving coal and ash-handling equipment make a coal-fired installation clean, convenient, and dust-free.

If you plan to remodel or build a new plant, be sure to look into the low cost and convenience of bituminous coal. Consider coal's other advantages, too. It has reserves that are virtually inexhaustible. America's bituminous coal mining industry is the most efficient and productive in the world. With bituminous coal, you can be sure of plenty of fuel at relatively stable prices now and for years to come.

If you operate a steam plant, you can't afford to ignore these facts!

BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for *hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Southern Building, Washington 5, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

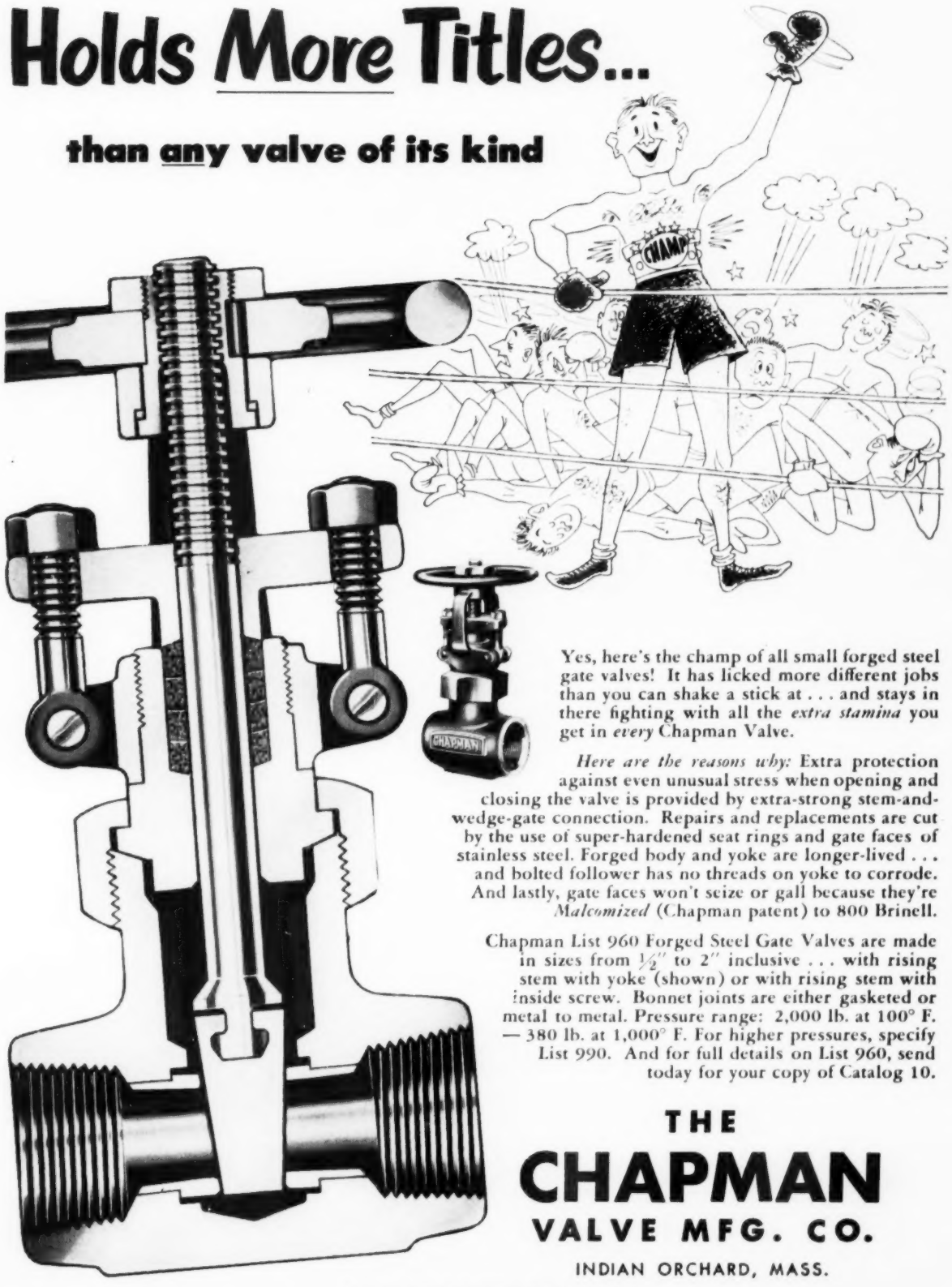
YOU CAN COUNT ON COAL!

For more data circle 603 on Post Card

CHAPMAN LIST 960

Holds More Titles...

than any valve of its kind



Yes, here's the champ of all small forged steel gate valves! It has licked more different jobs than you can shake a stick at . . . and stays in there fighting with all the *extra stamina* you get in *every* Chapman Valve.

Here are the reasons why: Extra protection against even unusual stress when opening and closing the valve is provided by extra-strong stem-and-wedge-gate connection. Repairs and replacements are cut by the use of super-hardened seat rings and gate faces of stainless steel. Forged body and yoke are longer-lived . . . and bolted follower has no threads on yoke to corrode. And lastly, gate faces won't seize or gall because they're *Malcomized* (Chapman patent) to 800 Brinell.

Chapman List 960 Forged Steel Gate Valves are made in sizes from ½" to 2" inclusive . . . with rising stem with yoke (shown) or with rising stem with inside screw. Bonnet joints are either gasketed or metal to metal. Pressure range: 2,000 lb. at 100° F. — 380 lb. at 1,000° F. For higher pressures, specify List 990. And for full details on List 960, send today for your copy of Catalog 10.

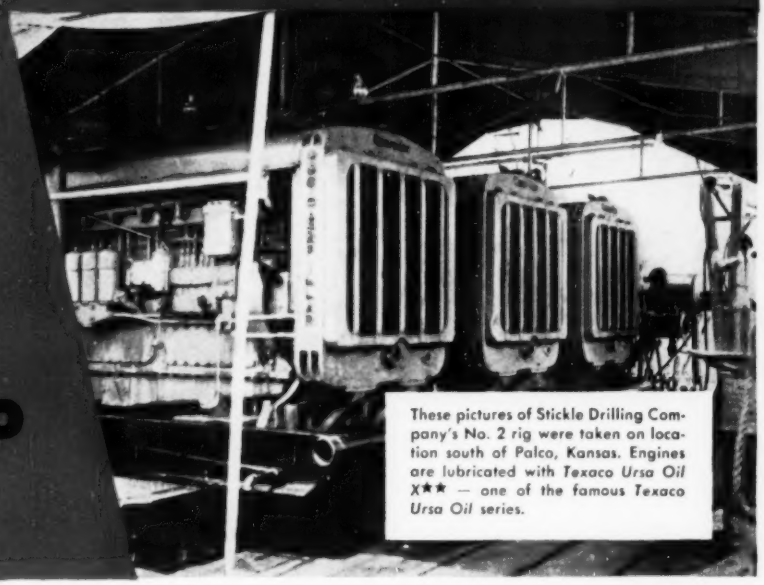
THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASS.

For more data circle 604 on Post Card

28,540 HOURS' OPERATION... WEAR LESS THAN .001"

Stickle Drilling Company's Diesels are lubricated with TEXACO URSA OIL



These pictures of Stickle Drilling Company's No. 2 rig were taken on location south of Palco, Kansas. Engines are lubricated with *Texaco Ursa Oil* X★★ — one of the famous *Texaco Ursa Oil* series.

Stickle Drilling Company, Tulsa, Oklahoma, has long been getting outstanding performance from Diesels lubricated with *Texaco Ursa Oil*. Typical are the three Caterpillar Diesels operating the No. 2 drilling rig. These were taken down for inspection after 28,540 hours of operation, and the following report gives the story:

"We found that *Texaco Ursa Oil* had kept these engines ideally clean. Measured wear was under one-thousandth of an inch. Since then, the engines have been back in operation for over 10,000 additional hours without any down time."

You can get similar fine performance by using the recommended member of the famous *Texaco Ursa Oil* series — *a complete line* of lubricating oils for Diesel, gas and dual-fuel engines. Whatever the type, size or speed of your engines, their operating conditions or fuel used, there is a *Texaco Ursa Oil* to assure clean, efficient performance with minimum maintenance costs and fuel consumption. The *Texaco Ursa Oil* series is approved by leading engine builders and preferred by operators everywhere.

A Texaco Lubrication Engineer will gladly give you full information. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

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